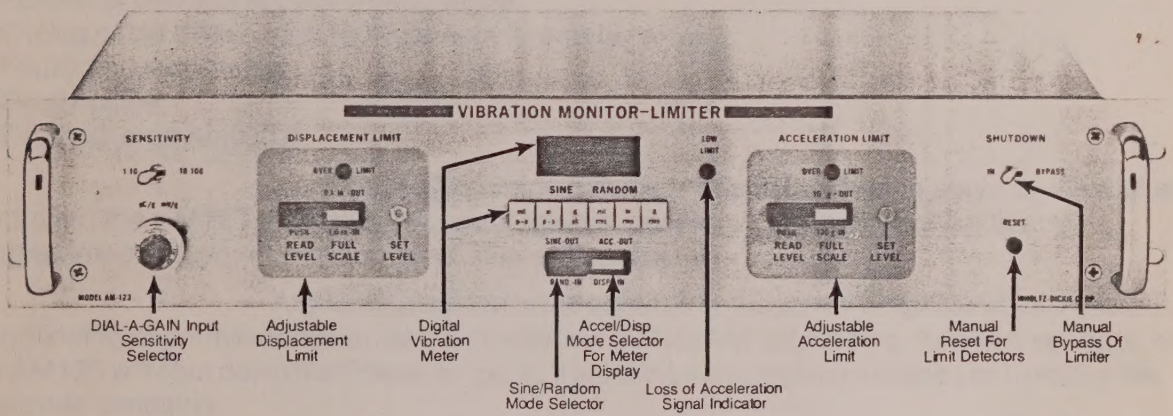
UNHOLTZ-DICKIE CORPORATION

VIBRATION TEST EQUIPMENT

Electronic Services - Hayward, Ca
M20650X

MODEL AM-123



GENERAL ELECTRIC
INSTRUMENTATION & COMMUNICATION
1200 KONA DRIVE
COMPTON, CA 90220
(213) 642-5317

FEATURES

OPERATES WITH ANY SERVO OR DIGITAL CONTROL SYSTEM.

ACCELERATION AND DISPLACEMENT MONITORED AND LIMITED SIMULTANEOUSLY.

INDEPENDENT ADJUSTMENT OF ACCELERATION AND DISPLACEMENT LIMITS.

SECONDARY PROTECTOR REMOVES P.A. POWER IF LIMIT IS EXCEEDED AFTER COMPRESSION OCCURS.

DIGITAL DISPLAY OF VIBRATION LEVEL AND LIMIT THRESHOLDS.

SMOOTH, TRANSIENT FREE COMPRESSION WHENEVER EITHER LIMIT IS EXCEEDED.

INTERNAL CHARGE CONVERTER AND DIAL-A-GAIN SENSITIVITY ADJUSTMENT.

PUSHBUTTON SELECTION OF:

sine or rand
accel or dis
meter full sc

MP MASTER
MA34554

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COMPTON, CA 90220
(213) 642-8317

The Model AM123 provides effective overtest protection for shakers and test specimens in the event of operator errors or system malfunctions which would otherwise cause the vibration level to exceed the desired test level. The AM123 can be used for both sine and random testing. It can operate with manual or automatic equalizers, sine servos, averagers and peak selectors as well as digital control systems.

The primary function of the AM123 is to provide specimen overtest protection, particularly in the following situations:

1. The AM123 provides protection during shaker system start-up period where large servo errors occur, and when conventional protection devices must be deactivated. In addition, the AM123 allows for step changes in multi-level sine tests without "error" shutdown. The following familiar problem areas are eliminated:
   - Failure to connect accelerometer cable
   - Wrong cable attached in multiple accelerometer array
   - Faulty accelerometer
   - Faulty cable
   - Faulty charge amplifier
2. If a programming error is made in the analog servo or the digital controller, the AM123 will typically protect the test specimen since AM123 limits are programmed independently and in a different manner.
3. Any fault condition in the controls or the power amplifier which results in a continuing overdrive condition at the shaker will initiate AM123 limiting. Auxiliary contacts in the AM123 will shut down the Power Amplifier if input signal compression does not remove the overdrive condition.
4. When testing small to intermediate size specimens where single point control is practical, a separate (redundant) accelerometer can be utilized for the AM123 input, providing a completely independent data channel for monitoring and limiting.

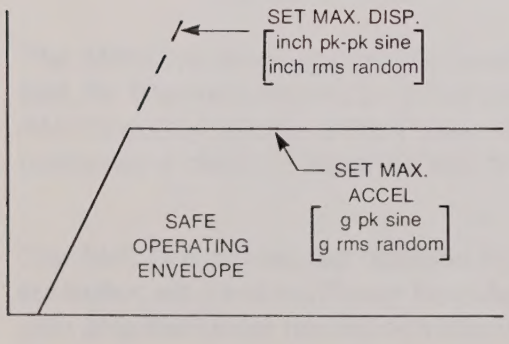

FIGURE 1. Easy to program test limits provide unmistakable safe operating envelope.

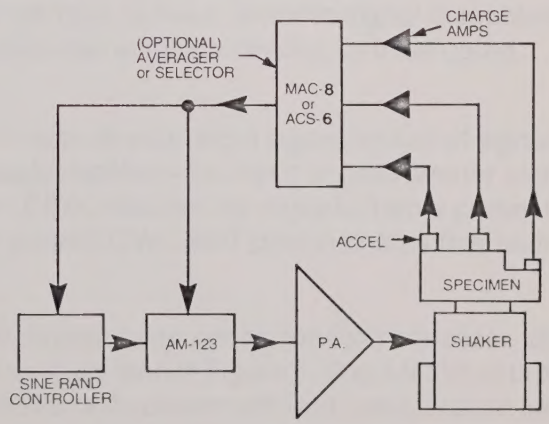

FIGURE 2. Typical system configuration showing AM-123 with averager or selector in multiple accelerometer control set up.

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Vibration amplitude is displayed in terms of acceleration or displacement on a 2½ digit meter for either sine or random operation. The decimal point is automatically positioned, and the display indicates the selection of acceleration or displacement with the appropriate units.

A "push-to-read" momentary switch and potentiometer adjustment for displacement and acceleration limits assure simple, convenient programming. Direct display of each limit value on the digital vibration meter provides an unmistakable indication of the safe operating envelope selected, as suggested in FIGURE 1. The limiting values may be set before or during system operation and displayed at any time without interruption of operation.

The AM123 includes an internal charge converter and sensitivity normalizing circuit (Dial-A-Gain) permitting direct inputs from accelerometers with 1-100 pC/g sensitivities. The AM123 will also accept a low impedance voltage input such as a normalized 10 mV/g signal. The internal charge converter allows the AM123 to be utilized as a convenient, stand alone vibration monitor.

For limit detection, acceleration and displacement signals are full-wave rectified and averaged. Averaging of the detector signal provides low probability of shutdown due to spurious noise spikes. For operation with automatic sine controls such as the U-D Models OSP-4, OSC-1/SPA-7, as well as other sine controllers, the AM123 detection time constant and internal compressor speed are varied as a function of operating frequency utilizing an internal frequency-to-DC converter which operates on a fixed amplitude input from the sine oscillator (or digital controller). Thus, the AM123 response time is always many times faster than the closed loop response of the sine control. When a limit threshold is detected in the AM123, signal compression is performed and the servo interlock circuitry is interrupted, placing the servo into STANDBY mode. Also, this interrupt command may be used to trigger an ABORT in the digital controller. With the servo in STANDBY (or digital controller in ABORT), resetting of the AM123 limit detectors and compressor cannot result in a drive signal being applied to the Power Amplifier. Both AM123 limit detectors are latching, and each over-limit condition is indicated by a front panel LED.

If the vibration level exceeds the programmed limit(s) for more than 100 msec, auxiliary contacts place the Power Amplifier into STANDBY.

For random operation, the input signal to the Power Amplifier is also interconnected through the AM123 compressor. In this mode the response time is fixed. Smooth signal compression is provided, and simultaneously the random equalizer interlock circuitry is interrupted.

The AM123 protects against startup without an acceleration input signal, or loss of signal during a test. An internal comparator circuit continuously monitors the input accelerometer signal versus AM123 output voltage to the Power Amplifier. If this relationship departs from a preset value, the compressor circuit is triggered and the front panel LOW LIMIT pilot indicates this fault mode.

The AM123 is connected between the signal source (sine servo, random equalizer, digital controller, etc.) and the Power Amplifier input as illustrated in Figure 2. The AM123 acts as a unity gain amplifier under normal conditions. Whenever a displacement limit, acceleration limit, or loss of acceleration signal (LOW LIMIT) is detected, the AM123 internal compressor circuit smoothly attenuates the drive signal.

1. **FREQUENCY RANGE** — 5 Hz to 5 kHz

2. **INPUTS**

   2.1 Charge input: Adjustable for sensitivities 1-100 pC/g in two ranges; rear-panel selection of 2.1 or 2.2.

   2.2 Voltage input: Adjustable for sensitivities 1-100 mV/g in two ranges; input impedance 100K (adjust to 10 mV/g for signal conditioners).

   2.3 Random/Sine input: 13 V peak; input impedance 100K.

   2.4 Lin DC — Frequency Input 2 mV/Hz, 10 V max; normally generated internally by frequency-to DC Converter operating on 2.5.

   2.5 Osc Input: .3V to 3V rms fixed amplitude sinewave (1 V rms typical)

3. **OUTPUTS**

   3.1 Random/Sine output: Normally unity gain ±5%; compresses to an attenuation of greater than 80 dB upon command from TTL limit detection circuit.

   3.2 Acceleration: 1 V peak for full scale input; 10 V max.; frequency response ± 1% 5 Hz to 5 kHz.

   3.3 Displacement: 1 V peak for full scale input; 10 V max.; frequency response ±3% 5 Hz; ±1% 10 Hz to 1 kHz.

   3.4 Shutdown Controls:
   (1) TTL logic 1 for normal operation, logic 0 for shutdown; for SPA-7 or OSP-4 and internal compressor.
   (2) N.C. contacts opening when internal compressor compresses approximately 80 dB to cause other sine controllers to go to standby mode. N.O. contacts optional.
   (3) N.C. contacts opening 100 ms after limit detection if overlimit condition has not been corrected. N.O. contacts optional.

   3.5 Digital Meter: 2½ digit display; resolution ± LSD, decimal point automatically placed; reads peak acceleration and peak to peak displacement for sine, and rms values for random signals. Max. reading 199% of nominal full scale value.

   3.6 Function Indicators: Six lamps show function measured and units of measurement. See 4.1 and 4.2.

4. **OPERATING CONTROLS**

   4.1 Acceleration Ranges: 10 g, 100 g full scale (peak sine or rms random) (two lamps).

   4.2 Displacement Ranges: 100 mil, 1.0 full scale (p-p sine or rms random) (four lamps).

   4.3 Range switches push in or out to select full scale ranges for monitoring and limiting.

   4.4 Mode switch pushes in or out to select random or sine operation.

   4.5 Function switch pushes in or out to determine displacement or acceleration monitoring on meter; Operation in 5.3 overrides this selection.

5. **LIMITING**

   5.1 Displacement and acceleration values separately adjustable from 1% to 199% of full scale value.

   5.2 Exceeding either limit immediately trips latching TTL protection circuits and shows overlimit on front panel LED indicators.

   5.3 Momentary contact pushbutton displays limit values on digital meter.

   5.4 Low Limit Detector: Internal comparator monitors output voltage to P.A. versus acceleration and displacement response signal. If 10% (typical) of full P.A. drive voltage results in response signal less than 5% of selected full scale range value for accel or disp limit, compressor is triggered and front panel LED indicates Low Limit fault. Adjustability provided for percentage of drive voltage and percentage of full scale accel and disp comparator inputs.

6. **RESPONSE TIMES**

   6.1 Detection time constant
   Sine: Controlled by lin. frequency signal—at least 5 times faster than servo time constant.

5 Hz –	200 ms	
150 Hz –	6 ms	Typical values
5 kHz –	.2 ms	

   Random: Constant at approximately 300 ms for acc.; 2 sec for displacement.

   6.2 Compression time for 80 dB compression (internal compressor-SPA-7 and OSP-4 characteristics similar).

   Sine: Controlled by lin. freq. signal

5 Hz –	500 ms	
150 Hz –	150 ms	Typical values
5 kHz –	5 ms	

   Random: Constant at approximately 50 ms.

7. **OTHER CONTROLS**

   7.1 Shutdown Switch (In-Bypass): Bypass position prevents outputs in 3.4 from being active.

   7.2 Reset: Momentary depression resets limit latches, and returns internal compressor to unity gain. Test is resumed by usual techniques which return sine servo from standby to operate mode.

8. **POWER:** 105-125/210-250 V AC 50-60 Hz 10 VA

9. **SIZE:** 3.5" high × 19" wide × 11" deep + cables.

UNHOLTZ-DICKIE CORPORATION

3000 Whitney Avenue • Hamden, Connecticut • 06518

Telephone (203) 288-3358

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BULLETIN AM-123-79

OPERATING AND SERVICING INSTRUCTIONS

MODEL AM-123

SERIAL NO. 228

VIBRATION MONITOR-LIMITER

UNHOLTZ-DICKIE CORPORATION
6 Brookside Drive
Barnes Industrial Park North
Wallingford, Conn. 06492

AM-123

INTERCONNECTION

CAUTION

The LIN DC of the AM123 may be an INPUT or an OUTPUT signal. When only an oscillator signal is available, the N board provides a linear DC Output signal to the LIN DC Jack and also to the internal circuitry if the oscillator signal is connected to OSC IN. But when an external linear DC signal is to be used, the N board MUST BE REMOVED and the linear DC signal brought in through LIN DC.

The compression speed is controlled by a linear DC signal proportional to the testing frequency. The N board produces a 2 mV/Hz linear DC signal. This allows the instrument to be used in other systems where no linear DC signal is available. All units sold are provided with an N board. If the board is not in the unit, it will be with the accessories.

In some of our systems we purposely remove the N board. In doing so an external linear DC signal is required. Systems that contain a MAC-8 or a SRP-3 are two such systems.

The SRP-3 contains its own frequency to DC converter. With an oscillator signal to OSC IN of the SRP-3, the LIN DC of SRP-3 is connected to LIN DC of the AM123. Note: the N board of the AM123 is removed.

The MAC-8 is an eight channel multiplexer, used in average controlling. The detection speed of the AM123 may cause problems when used with a MAC-8. Further explanation found in paragraph 3.6 of the AM123 manual. An external LIN DC signal is connected to LIN FREQ IN of the MAC-8 then from LIN FREQ OUT to LIN DC of the AM123. Note: the N board of the AM123 must be removed.

In short if the N board of the AM123 is in the unit, the LIN DC BNC is an OUTPUT and an oscillator signal is required to OSC IN. If the N board is removed, the LIN DC BNC is an INPUT and a linear DC signal is required in LIN DC of the AM123.

AM123 FACTORY SETTINGS

S/N 228

Front Panel

SENSITIVITY ..... 10 pC/g or mV/g

DISPLACEMENT LEVEL..... 100 mils P-P

ACCELERATION LEVEL..... 10 g pk

Rear Panel

LOW LIMIT..... 5% FULL SCALE

Definition: With voltage to the P.A. greater than set in next step, the acc. or disp. signal must be greater than "Low Limit".

VOLTAGE.....

Maximum drive voltage with acc. or disp. signal below "Low Limit".

HIGH ☒ VELOCITY SYSTEM	LOW ☐ VELOCITY SYSTEM	FULL SCALE
0.5 V PK (100 Hz)	1 V PK (100 Hz)	10 g PK
0.64 V PK (100 Hz)	1.28 V PK (100 Hz)	100 g PK
0.26 V rms (Random)	.52 V rms (Random)	10 g rms
0.6 V rms (Random)	1.2 V rms (Random)	100 g rms

FREQUENCY TO DC CONVERTER BOARD N

☐ IN UNIT ☒ WITH ACCESSORIES

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2. Controls-Connectors
3. Operation
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5. Maintenance-Servicing
6. Schematics-Layouts
7. Specifications

1. GENERAL DESCRIPTION

FEATURES

- Sine or Random Operation.
- Simultaneous monitoring of acceleration and displacement.
- Independently adjustable limiting values for acceleration and displacement.
- Smooth or "thump-free" compression if either limiting value is exceeded.
- Latching circuits and LED limit indication.
- Secondary protector removes amplifier power if limit is exceeded after compression occurs.
- Digital display of vibration level or limiting values.
- Internal charge converter and accelerometer sensitivity normalizer.
- Push button operation.
- Low-level signal shutdown.

The Model AM-123 provides protection for the shaker and test specimen from system malfunctions which can cause the vibration level to exceed the programmed test levels. Typical system malfunctions include damage to the control accelerometer cable, operator error, or component failure in the power amplifier. The AM-123 is compatible with manual or automatic random equalizers/analyzers and with sine vibration servos.

The AM-123 has an internal charge converter and a sensitivity normalizing circuit (Dial-A-Gain) so that signals directly from accelerometers having sensitivities from 1 to 100 pC/g may be used. For maximum protection, this accelerometer should not be the control accelerometer. Provision for accepting a low impedance input from a signal conditioner is also made. Acceleration and displacement signals are available at the rear panel for monitoring purposes.

The operating acceleration or displacement level may be selected for front panel display on a 2½ digit meter for either random or sine operation. The decimal point is automatically positioned and a display light indicates the selection of either acceleration or displacement and the measurement units. The limiting values for acceleration and displacement are displayed by depressing front-panel pushbuttons and adjusted by means of front-panel controls.

For limit detection, both acceleration and displacement signals are full-wave rectified and averaged. For sinusoidal operation with the Models OSP-4 or SPA-7 the averaging time is controlled by the operating frequency so that the response time of the AM-123 is many times faster than the closed-loop response of the controlling servo. Thus when the limiting value is detected in the AM-123, the OSP-4 or SPA-7 is signaled to compress smoothly or return to the standby mode before the vibration amplitude has increased appreciably at any operating frequency. The averaging of the detected signal gives low probability of shutdown due to spurious noise spikes. If the vibration level still exceeds the limit after 100 milliseconds, relay contacts operate to put the power amplifier in the standby mode.

For sinusoidal operation with other servos, a compressor inside the AM-123 causes the compression of the input signal. Following smooth 80 dB compression of the input signal, the AM-123 provides relay contacts which put the servo in the Standby mode. Backup protection with amplifier shutdown is also supplied.

For random operation, the averaging time is fixed. In addition, the excitation signal for the power amplifier is passed through the internal compressor in the AM-123. This compressor provides the smooth shutdown for random operation, and relay contacts then interrupt the interlock circuit of the random equalizer.

Both limit detectors are latching and each overlimit condition is indicated by a lighted LED. Resetting the limit indicators is accomplished by a pushbutton. The pushbuttons which are not momentary contact change indicator color from black to white when pushed in.

In addition protection against loss of signal from the monitor accelerometer is also provided. When the servo is initially turned on, the output of the AM-123 will be compressed smoothly if the output voltage of the internal compressor exceeds a preset level before the monitored displacement or acceleration level exceeds a small percentage of the front-panel full-scale values. Both the critical output voltage and the low-limit vibration level are internally adjustable. Should the monitor signal be lost during the test, the output is compressed smoothly to zero.

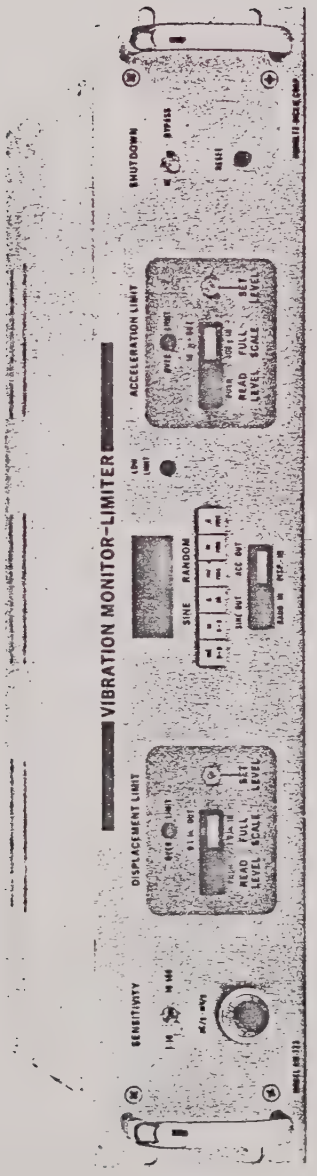


Fig. 2.1

MODEL AM-123 - FRONT PANEL DETAILS

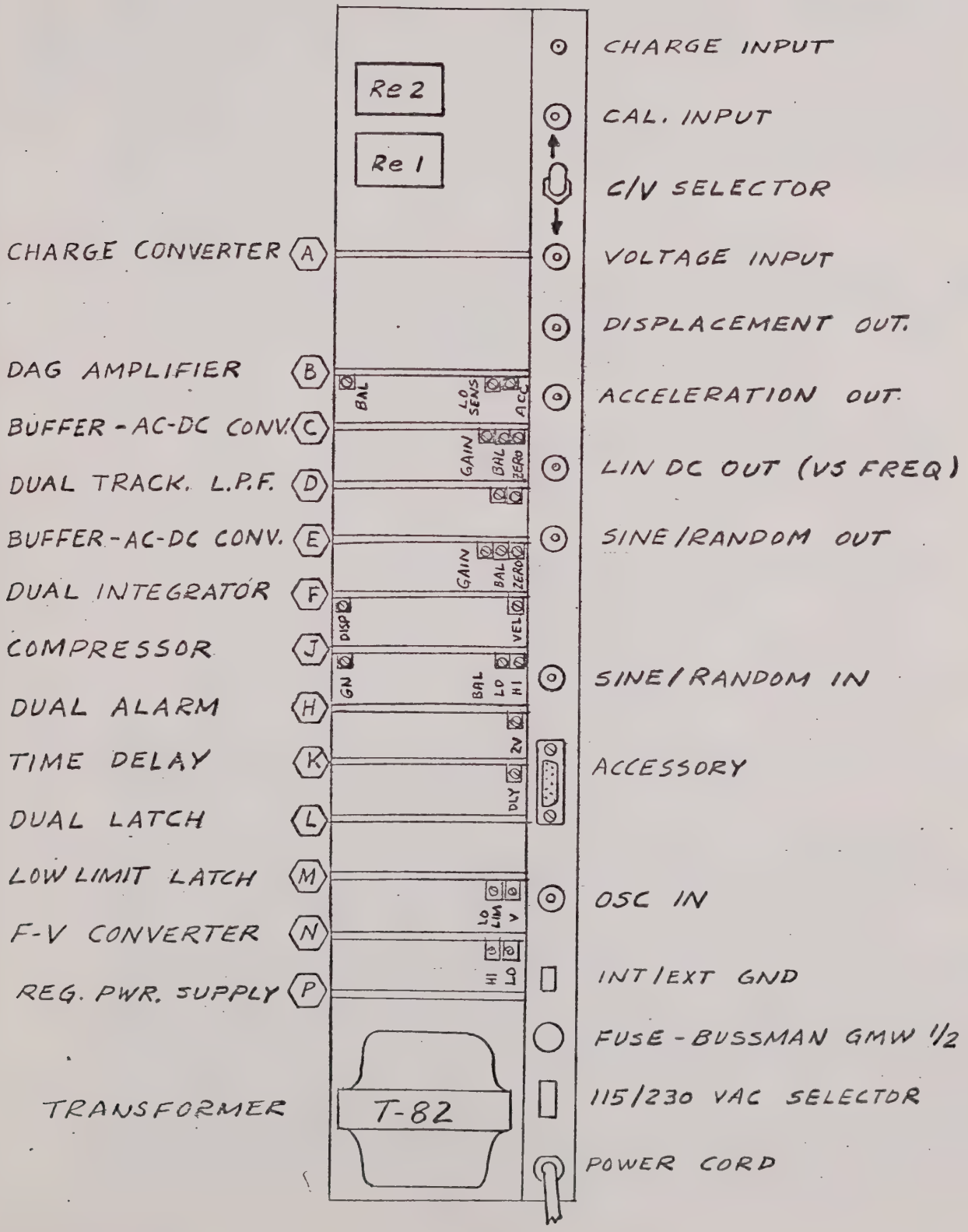

Re 2
Re 1
CHARGE CONVERTER A
DAG AMPLIFIER B
BUFFER - AC-DC CONV. C
DUAL TRACK. L.P.F. D
BUFFER - AC-DC CONV. E
DUAL INTEGRATOR F
COMPRESSOR J
DUAL ALARM H
TIME DELAY K
DUAL LATCH L
LOW LIMIT LATCH M
F-V CONVERTER N
REG. PWR. SUPPLY P
TRANSFORMER
T-82
BAL
LO SENS
ACC
GAIN
BAL
ZERO
DISP
VEL
GN
LO
HI
2V
DLY
LO LIM V
HI
LO
CHARGE INPUT
CAL. INPUT
C/V SELECTOR
VOLTAGE INPUT
DISPLACEMENT OUT.
ACCELERATION OUT.
LIN DC OUT (VS FREQ)
SINE/RANDOM OUT
SINE/RANDOM IN
ACCESSORY
OSC IN
INT/EXT GND
FUSE - BUSSMAN GMW 1/2
115/230 VAC SELECTOR
POWER CORD

FIG 2.2 .

2. CONTROLS-CONNECTORS

The front-panel controls are shown in Fig. 2.1 and rear-panel details are shown in Fig. 2.2. All toggle switches are locking and must be pulled out before the position is changed. Sections 2.1 through 2.8 apply to front-panel controls.

2.1 SENSITIVITY (pC-mV/g) - The ten-turn SENSITIVITY DIAL is set to correspond with the significant digits of the accelerometer (or signal conditioner) sensitivity. The RANGE SWITCH selects the proper range.

2.2 DISPLACEMENT LIMIT (See also 2.4)

2.2.1 FULL SCALE - The push-in, push-out button provides two full scale ranges for the monitoring and the limiting functions. For the OUT position the 100 mil range applies (button color-black). For the IN position the 1.0 in range applies (button color-white).

2.2.2 READ LEVEL - Depressing this momentary contact button causes the displacement limit to be displayed on the digital meter. Decimal point placement is automatic. The control overrides any monitoring function.

2.2.3 SET LEVEL - Adjustment of this multiturn potentiometer to set the displacement limit is best accomplished while depressing the READ LEVEL button. Limit values up to 199% of full scale may be obtained.

2.2.4 OVER LIMIT - The LED indicator lights and remains lit when the displacement level has exceeded the limiting value determined by the SET LEVEL control.

2.3 ACCELERATION LIMIT - The operation of the controls is similar to the operation for the DISPLACEMENT LIMIT controls in 2.2, except that the full scale ranges are 10 g and 100 g.

2.4 VIBRATION METER - The 2½ digit meter displays the monitored acceleration or displacement level unless either READ LEVEL button is depressed. In the latter case the appropriate LIMIT value is displayed. In the monitoring mode the decimal point is automatically positioned by the ACC-DISP switch and the corresponding FULL SCALE range switch. The units of measurement are determined by the SINE-RANDOM switch. The correct units of measurement, i.e. mil p-p, in p-p, or g pk for SINE operation and mil rms, in rms, or g rms for RANDOM operation are always displayed by the appropriate indicator light below the display, regardless of whether the monitored or limiting value is displayed.

Readings up to 200% of nominal full scale value may be accurately obtained. For readings of 200% or over, the initial digit remains at unity and the other two digits flash.

2.5 SINE-RANDOM - The pushbutton should be left OUT for SINE testing (black background) or pushed IN for RANDOM testing (white background). Note that rms values apply for both the monitoring and limiting functions for RANDOM testing. The S-R switch also controls the compression speed.

2.6 DISP-ACC - The pushbutton determines the vibration function displayed for the monitoring function only. ACCELERATION is displayed in the OUT (black background) position and DISPLACEMENT is displayed for the IN position (white background). Depressing the READ LEVEL switch overrides the DISP-ACC switch.

2.7 SHUTDOWN - For the IN position, this locking toggle switch allows all shutdown commands to be transmitted to appropriate locations in the vibration system. If the monitored level exceeds the preset limit, the appropriate OVER LIMIT indicator lights, the internal compressor in the AM-123 compresses to minimum gain, and a digital signal is instantly transmitted to the UD Model OSP-4 or SPA-7 to put that servo in the STBY mode. If the limiting condition still exists after 100 millisec. a set of relay contacts also changes state, so that the interlocks of a power amplifier may be interrupted.

For the BYPASS condition, only the OVER LIMIT indicator will light, and all other shutdown functions do not occur.

2.8 RESET - Following an OVER LIMIT condition the RESET button must be depressed to initiate return to normal operation. The OVER LIMIT indicator goes out, the internal compressor returns to maximum gain, and the relays return to their normally operating states.

For the BYPASS mode in 2.7 depressing the RESET button is still necessary to reset the TTL latches and extinguish the OVER LIMIT indicators.

The following sections apply to REAR PANEL controls and connectors. See Fig. 2.2.

2.9 CHG. IN. - The Microdot connector accepts a signal input directly from a piezoelectric accelerometer through a noise-treated cable. Accelerometer sensitivities from 0.5 to 100 pC/g may be accommodated.

2.10 CAL - The isolated BNC connector accepts a signal voltage from an oscillator for calibration purposes. The internal 1000 pf ±½% capacitor gives a 1 mV/pC conversion, and the SENSITIVITY setting may be interpreted in mV/g. The connector should be shorted with the attached cap when not in use.

2.11 VOLT. IN - The isolated BNC accepts a signal from an external signal conditioner. The input impedance is 100 kilohm and the input is not suitable for a direct connection to an accelerometer. The SENSITIVITY setting is interpreted in mV/g, although a setting of 10 mV/g will usually be required.

2.12 C-V SELECTOR - The locking toggle switch accepts inputs from CHG. IN and CAL in the C position or from VOLT IN in the V position. Note that the CAL input is only active in the C position.

2.13 ACC. OUT - The isolated BNC provides an acceleration signal of 1 V peak for a full scale input signal of either 10 g or 100 g peak (sine signals). For random operation, full-scale inputs of 10 g or 100 g rms produce 1 V rms output. Note that 10 V peak output may be obtained without clipping.

2.14 DISP OUT - The isolated BNC provides a displacement signal of 1 V peak for a full scale input signal of either 100 mil or 1.0 in p-p for sine signals. For random operation full scale inputs of 100 mil or 1 in rms produce 1 V rms output. A peak undistorted output of 10 V is available.

2.15 LIN DC - The isolated BNC provides a DC signal proportional to the fundamental frequency of the signal at the OSC IN jack at a sensitivity of 2 mV/Hz. (See 2.25) See 3.6 for use with MAC-8.

2.16 S-R IN - The isolated BNC accepts a 9 V rms signal from the compressor output of a sine vibration servo or a 4 V rms signal from the output of a manual or automatic random equalizer.

2.17 S-R OUT - At maximum compressor gain the isolated BNC provides at least 9 V rms to drive the power amplifier for sine operation or 4 V rms for random operation. At minimum gain, this signal is reduced by at least 80 dB.

2.18 ACCESSORY (J1) - The DBC-9S connector has locking tabs and the mating connector and pins are supplied. The functions of the pin connections are found in the following table. Should other contact closures besides NC be required, consult factory.

PIN	FUNCTION	
1	Signal Reference	
6	Normally +5 V regulated - short circuit protected (may have other function if used for special feature.)	
7	TTL logic signal to OSP-4 or SPA-7 0/1 for STBY/OPERATE	
9	NC	Relay contacts for interrupting amplifier interlocks. Relay is normally excited.
5	Common	
8	NC	Relay contacts for interrupting sine servo interlocks (except OSP-4, and SPA-7) and also interlocks for random control system. Relay is normally excited.
4	Common	
3	NC	
2	Common	

Table 2.1 Connector J1 Pin Functions

2.19 INT - EXT GND - Use EXT position if chassis to signal reference connection has been established elsewhere. INT position connects chassis to signal reference in the AM-123.

2.20 115/230 V - Place slide switch in position matching AC line voltage (±10%).

2.21 FUSE - Bussman GMW ½ for 115 V AC
GMW ¼ for 230 V AC

2.22 The VOLTAGE potentiometer on Card M provides means for varying the critical compressor output voltage level in conjunction with the low-level shutdown detector. CW rotation decreases the critical output level.

2.23 The LOW LIMIT potentiometer on Card M allows the critical low level vibration to be adjusted from zero to approximately 100% of the full scale values indicated by the front panel F.S. RANGE switches. The lower of the levels represented by the displacement or acceleration levels is automatically used. CW rotation decreases the lower limit.

2.24 The LOW LIMIT front-panel indicator is a red LED which indicates that the monitored vibration level has fallen below the preset level in 2.23 and the AM-123 compressor voltage has simultaneously been above the critical level set in 2.22. Latching action keeps the indicator on after compression of the output voltage has occurred.

2.25 OSC IN - The isolated BNC accepts a signal the amplitude of which may vary from 50 mV p-p to 30 V p-p. It is usually connected to a constant amplitude oscillator voltage for sine testing. See 3.6 for use with MAC-8.

3. OPERATION

3.1 Input Connections

A piezoelectric accelerometer may be connected directly to CHG IN via a noise treated coaxial cable or the output from a signal conditioner may be connected to VOLT IN. Place the C-V SELECTOR in the appropriate position.

Set the SENS RANGE switch and the SENS DIAL to correspond to the sensitivity of the accelerometer or the signal conditioner. For the VOLT IN input the units are mV/g, and 10 mV/g is a common setting for the signal conditioner. Do not connect a piezoelectric accelerometer to VOLT IN, as it is not a high-impedance input.

3.2 Other Connections

The Figures listed in Table 3.1 show interconnection diagrams for the Model AM-123 when used with various sine control and random vibration systems.

Fig.	Title
3.1	With UD Model OSP-4
3.2	With UD Model SPA-7 and UD OSC-1 or SD104A-5
3.3	With UD Model SP Series or SD105 and UD OSC-1 or SD104A-5
3.4	With SD114A
3.5	Sine/Random System with UD E109B/E111 and Sine Servo and Oscillator
3.6	Alternate Input Connection

The above figures are not intended to be exhaustive. General rules for interconnection follow.

(1) For all sine servos, the servo or compressor output must be applied to the S/R IN and the S/R OUT excites the Power Amplifier.

(2) For all sine servos except the Models OSP-4 and SPA-7, pins 8 and 4 (J1) on the AM-123 are used in the interlock string, which when interrupted returns the servo to the STANDBY mode.

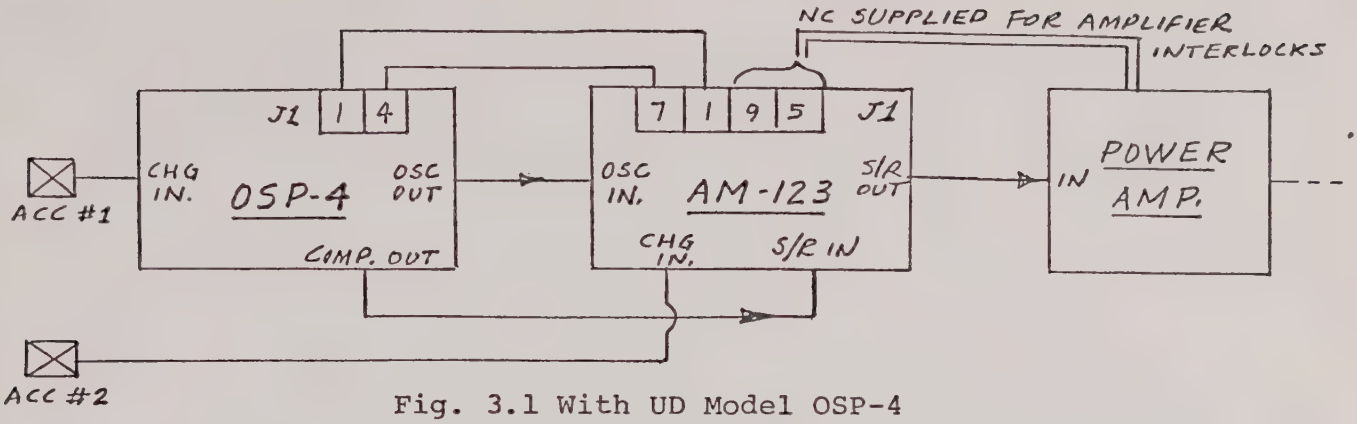


Fig. 3.1 With UD Model OSP-4

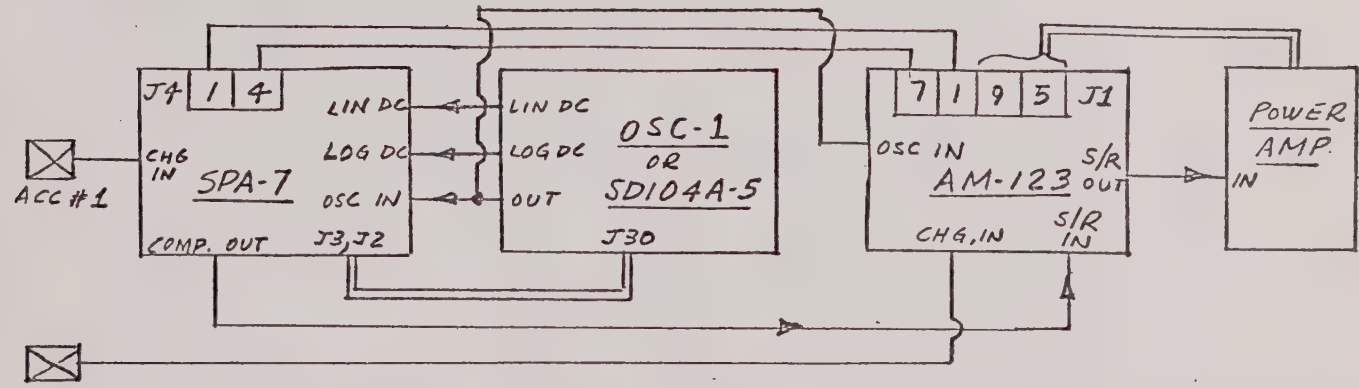


Fig. 3.2 With UD SPA-7 and UD OSC-1 or SD104A-5

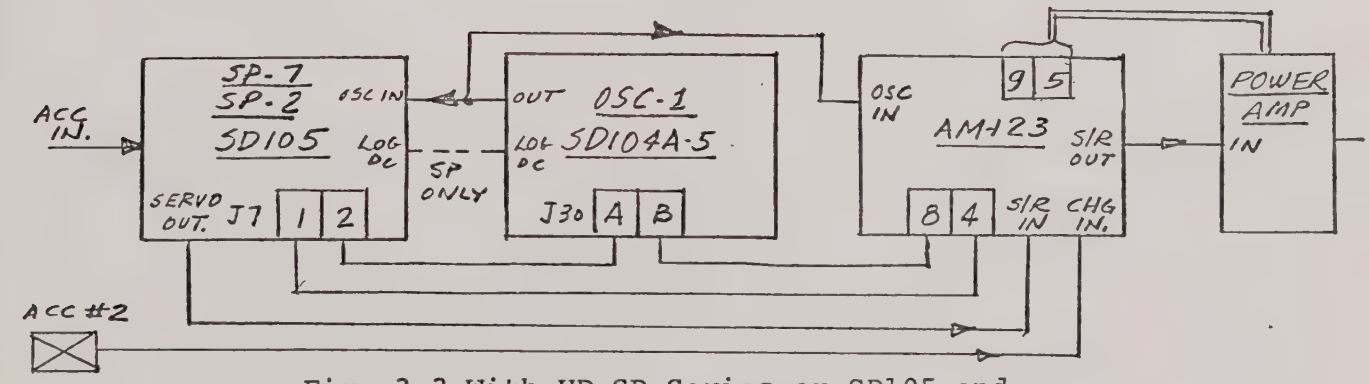


Fig. 3.3 With UD SP Series or SD105 and
UD OSC-1 or SD104A-5

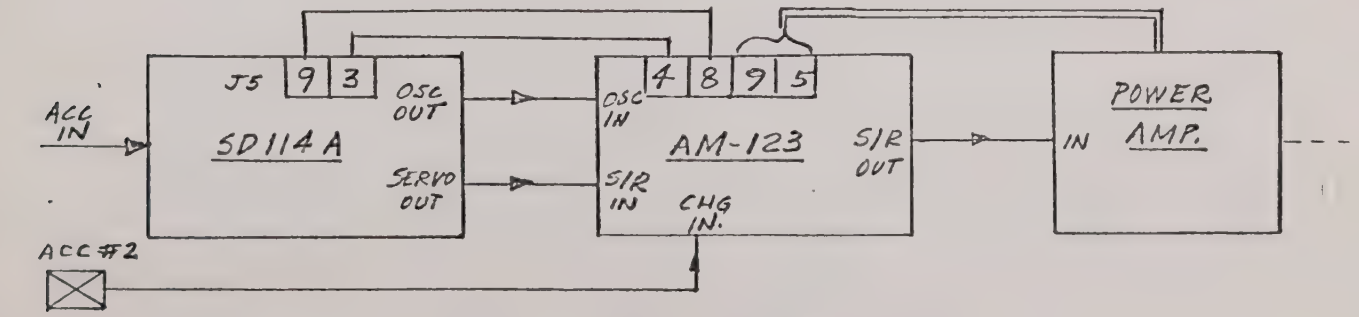


Fig. 3.4 With SD114A

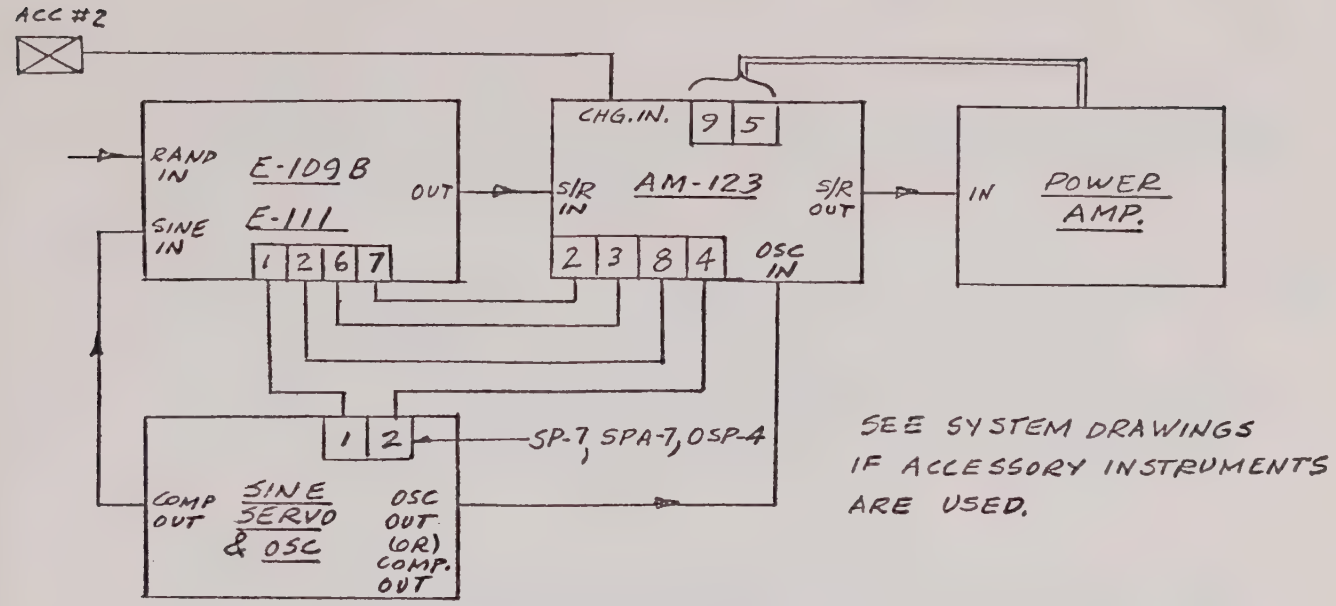


Fig. 3.5 Sine-Random System with E-109B/E-111 and Arbitrary Sine-Servo and Oscillator

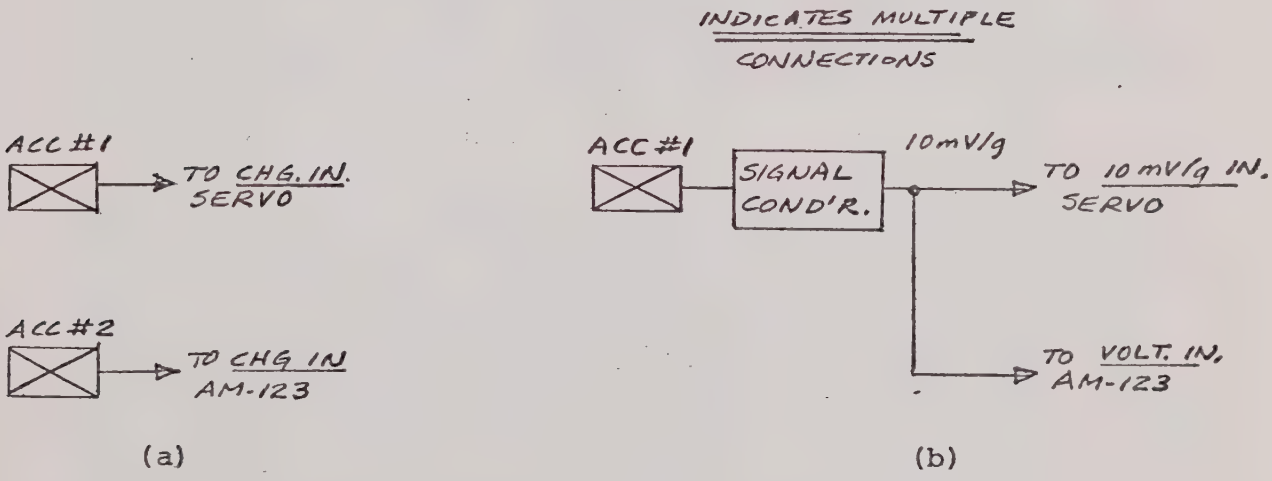


Fig. 3.6 Alternate Input Connection.

(3) Pins 9 and 5 (J1) on the AM-123 are connected to appropriate terminals in the power amplifier console so that excitation is removed from the output stages when the normal contact condition is interrupted.

e 3.6 also) (4) A signal (not necessarily sinusoidal), the frequency of which is equal to the test frequency must be applied to OSC IN for sine operation.

(5) For automatic and manual random systems (not shown) pins 8 and 4 (J1) or pins 3 and 2 on the AM-123, must be used to return the automatic random system to the STANDBY mode (full compression) when the normal contact condition is interrupted.

3.3 LIMIT Settings

The LIMIT settings should obviously be somewhat above the values of displacement and acceleration for the test program. For sine operation, leave the SINE-RANDOM selector OUT, and set the DISPLACEMENT and ACCELERATION LIMITS no lower than .5 dB above the corresponding values of the D-A test program. Closer LIMIT settings are likely to cause false alarms because of dynamic control errors due to the normal frequency sweep rate. For D-A-D-A programs, the LIMITS should be set above the first displacement test level, and the last acceleration test level of the program.

For random operation, push the SINE-RANDOM selector IN. A computation of the wide-band rms acceleration and the wide-band rms displacement should be available to assist in the determination of the LIMIT settings. The ACCELERATION LIMIT should be set no lower than 1 dB above the wide-band level. Otherwise statistical fluctuations of the detected and averaged wideband level may cause an OVER LIMIT triggering. The DISPLACEMENT LIMIT is suggested to be set at least 3 dB above the wide band level because the low frequency nature of the displacement signal causes the statistical fluctuations of the detected signal to be somewhat greater than those in the acceleration channel.

To effectively disable either the DISPLACEMENT LIMIT or the ACCELERATION LIMIT, push the corresponding FULL SCALE button IN, and turn the SET LEVEL potentiometer completely CW. This sets the chosen limit above 2 in or 200 g.

3.4 Operational Check

If possible, it is advisable to make a system check without the specimen attached to the shaker table to make sure that the AM-123 in conjunction with the other control equipment is working properly. Make sure that the LIMITS are set as in 3.3, and that the SHUTDOWN switch is in the IN position. Put the sine or random system in manual control with the GAIN control fully CCW. Depress the RESET button on the AM-123 if necessary, and increase the vibration level slowly until the LIMIT level is reached and signal compression is caused. For the sine system choose frequencies so that both the DISPLACEMENT and ACCEL LIMITS may be tested.

To check the secondary protection which removes power from the power amplifier, remove the connection to J1 on the OSP-4 or J4 on the SPA-7 (Figs. 3.1 or 3.2). For other servos remove the connections to S/R IN and S/R OUT on the AM-123 and connect the two loose BNC connectors with a female to female BNC adapter. This bypasses the AM-123 compressor. Then increase the signal level slowly until the amplifier power is tripped off. The required signal level should be about 1 dB larger than the DISPLACEMENT or ACCELERATION LIMIT.

3.5 Return to Normal Operation After Shutdown

3.5.1 Determine if possible the cause of the shutdown and correct any faults or problems before resuming operation. If the amplifier power has been removed, as well as the servo being returned to STBY, the problem may be a failure in either the amplifier or the servo.

3.5.2 For sine operation the servo should be in STBY. For random operation, an automatic system should be in STBY. Note the GAIN control position on a manual random system and turn it completely CCW.

3.5.3 Press the RESET on the AM-123. All LIMIT lights should extinguish.

3.5.4 For sine servos, check the set program levels and initiate the test in the usual manner. Reset the STBY circuit if necessary and then switch from STBY to SERVO ON, thus letting the test level be established automatically.

3.5.5 For automatic random systems initiate the test in the fashion recommended by the manufacturer. For manual random systems establish the wideband test level by rotating the GAIN control slowly CW.

3.6 With the MAC-8 Averaging Control

The output of the MAC-8 may be used to provide the 10 mV/g control signal for both the servo and the Model AM-123. Use the VOLT IN connector for the AM-123. A separate accelerometer for the AM-123 is not generally required since loss of one accelerometer does not disastrously change the average value.

The detection time of the AM-123 is many times faster than the closed-loop response of the controlling servo. The detection time is controlled by the operating frequency, which is converted to a Lin DC signal (2 mV/Hz). The AM-123 tries to detect each segment of the multiplexed signal from the MAC-8. The quick response of the AM-123 can cause false shutdowns.

In order to prevent unnecessary shutdowns one of two procedures must be done:

1) The detection levels of the AM-123 can be raised.
2) The detection time of the AM-123 can be lowered. (ie lower the Lin DC into AM-123).

The AM-123 produces its own Lin DC on board N. This board must be removed and an external Lin DC signal is first passed through the MAC-8, where it is attenuated by a factor of 10 before it is applied to Lin DC of the AM-123. This attenuation applies only when the MAC-8 is in the SINE PROGRAM mode. When the MAC-8 is in the BYPASS mode the DC signal is passed through with no attenuation.

3.7 LOW LIMIT Protection

The LOW LIMIT potentiometer is adjusted at the factory for a critical level of 5% of the front panel FULL SCALE switch positions. Should a lower/higher value for this limit be desired, turn the rear panel adjustment CW/CCW.

The VOLTAGE potentiometer is adjusted at the factory for a critical level of ≃.35V rms in 10 g sine operation. Automatically it is changed to ≃.45V rms in 100 g sine operation. For Random operation these numbers are increased to ≃.55 and ≃1.1 for 10 g and 100 g operation respectively. All values above can be changed according to system performance.

To perform this adjustment, repetitively turn the system on and return the system to full compression (STBY) using the usual controls on the sine servo controller. The servo should be set up for the desired test profile and turned on at the usual starting frequency. Turn the AM-123 VOLTAGE control CW until the AM-123 LOW LIMIT circuit automatically returns the system to STBY during the turn-on routine. Then turn the VOLTAGE control slightly CCW until the system will establish the programmed vibration level without activating the LOW LIMIT shutdown.

Should it be impossible to establish the programmed vibration level immediately following the turn-on command to the sine servo without activating the LOW LIMIT shutdown cycle, make sure there is an active monitor signal by viewing the ACC or DISP output on an oscilloscope. Then turn the VOLTAGE control CCW until the system will establish the programmed vibration level without shutting itself down automatically.

Should elimination of LOW LIMIT protection be desired, either remove Card M from the AM-123, or turn the multiturn LOW LIMIT adjustment fully CW.

4. CHECKOUT-CALIBRATION

Sections 4.1 through 4.8 constitute a complete but reasonably simple checkout procedure that can be adapted for periodic calibration purposes. Fig. 4.1 shows the card and adjustment location from the rear of the chassis with the top cover removed. The adjustment locations are also shown on the card layouts in Section 5.

4.1 Instruments Required

Oscilloscope	(HP1202B)
AC Voltmeter DC Voltmeter (digital)	} (Keithley 169 Autoranging DMM)
Ratio Transformer	(Singer RT-20R)
Universal Counter	(HP5325B)

All voltages measured with the ACVM should be viewed with the CRO.

4.2 ACCELERATION OUTPUT (A.C.)

The following table gives details of voltages, settings and adjustments for the calibration of the ACC OUT. Be sure the rear panel C-V selector is switched toward the input being used. Repeat lines 1 and 2 until measurements are within tolerance.

	INPUT VOLTAGE (CAL or VOLT IN) (100 Hz)	SENS	ACC. F.S. RANGE	ACC. OUT	ADJUSTMENT
1	100 mV rms	10 (1-10)	10 g pk	1.0 V rms ±1%	ACC - Card B
2	10 mV rms	1 (1-10)	10 g pk	1.0 V rms ±1%	LO SENS Card B
3	1 V rms	100 (10-100)	10 g pk	1.0 V rms ±1%	—
4	100 mV rms	10 (1-10)	100 g pk	100 mV rms ±1%	—

Table 4.1 ACC OUT Calibration

4.3 DISPLACEMENT OUTPUT (A.C.)

The following table gives details of voltages, frequencies, settings and adjustments for the calibration of the A.C. DISP. OUT. A counter should be used to set the frequency accurately. The input SENS should be 10 pC (mV)/g.

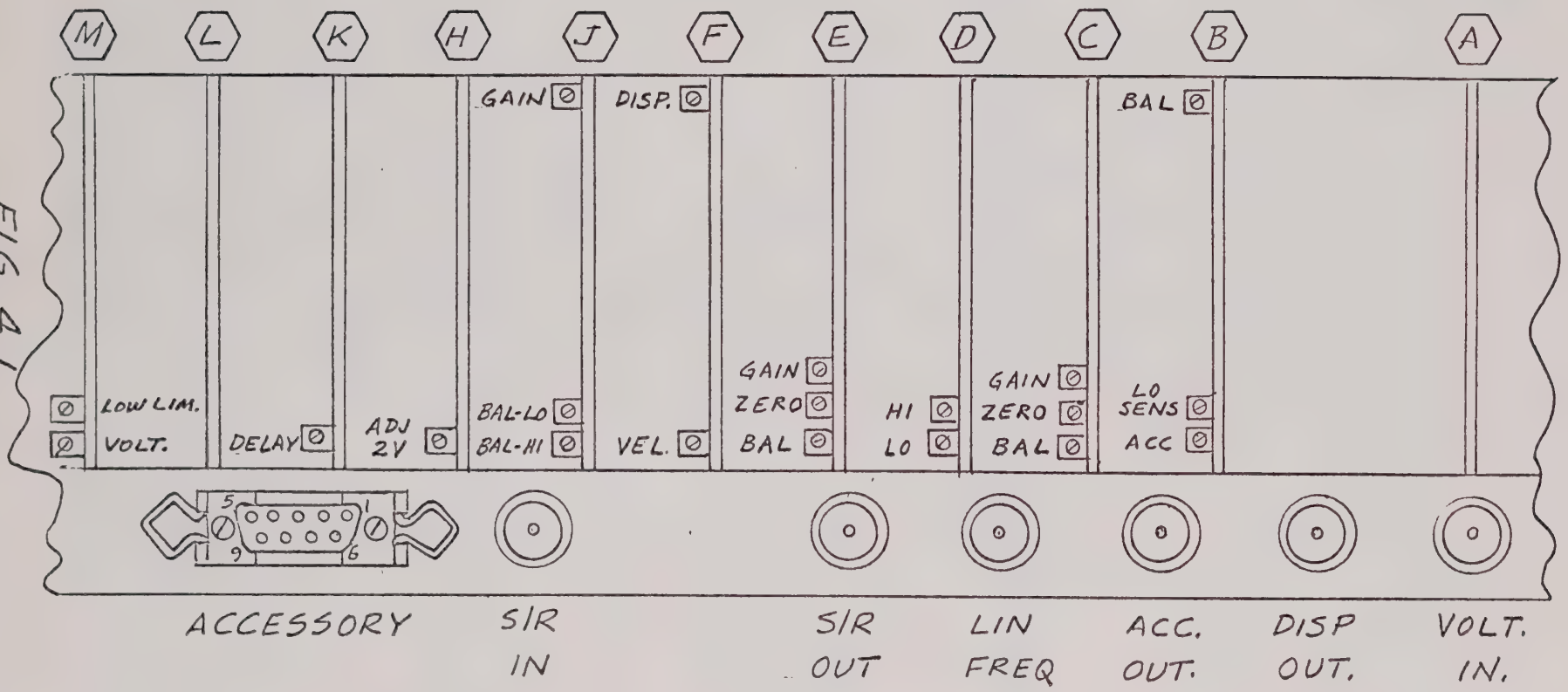

M
L
K
H
J
F
E
D
C
B
A
LOW LIM.
VOLT.
DELAY
ADJ 2V
GAIN
BAL-LO
BAL-HI
DISP.
VEL.
GAIN
ZERO
BAL
HI
LO
GAIN
ZERO
BAL
BAL
LO SENS
ACC
5
1
9
6
ACCESSORY
S/R IN
S/R OUT
LIN FREQ
ACC. OUT.
DISP OUT.
VOLT. IN.

FIG 4.1

INPUT VOLTAGE (VOLT IN)	FREQ (Hz)	DISP. F.S. RANGE	MEASURE	AT	ADJUST
162.8 mV rms	100	100 mil p-p	1.0 V rms ±1%	PIN 1 Card F	VEL. Card F
510 mV rms	100	100 mil p-p	1.0 V rms ±1%	DISP. OUT	DISP Card F
20.36 mV rms	20	100 mil p-p	1.0 V rms ±1%	DISP. OUT	-
5.10 mV rms	10	100 mil p-p	1.0 V rms ±2%	DISP. OUT	-
1.277 mV rms	5	100 mil p-p	1.0 V rms ±3%	DISP. OUT	-
203.6 mV rms	20	1 in p-p	1.0 V rms ±1%	DISP. OUT	-

Table 4.2 DISP. OUT Calibration

4.4 AC-DC CONVERTERS - DC MEASUREMENT

Use a digital DCVM to monitor the DC voltage for the measurements in Table 4.3. Make sure that OSC IN has an input of 1 V rms at the operating frequency and the S/R Selector is in the SINE position (OUT). The input SENS. is 10 pC(mV)/g.

	INPUT VOLTAGE (VOLT IN)	FREQ (Hz)	F.S. RANGE	MEASURE	AT	ADJUST
1	100 mV rms	100	10 g pk	1.414 V DC ±1%	Pin D Card D	GAIN Card
2	0 (short)	-	100 g pk	OVDC ±2 mV	Pin D Card D	See Sect4.
3	510 mV rms	100	100 mil p-p	1.414 V DC ±1%	Pin C Card D	GAIN Card
4	0 short pin 5 Card F to pin 6	-		OVDC ±5 mV	Pin C Card D	See Sect4.

Table 4.3 AC-DC Converter Calibration

4.5 TRACKING LOW-PASS FILTERS

Use the same settings as in 4.4 and monitor the outputs in Table 4.4 with an oscilloscope. The oscilloscope is used to measure the peak-to-peak second harmonic ripple which is added to the DC voltages measured in 4.4. A Lisajous pattern may be helpful. Repeat Lines 1 and 2.

	INPUT VOLTAGE (VOLT IN)	FREQ (Hz)	F.S. RANGE	MEASURE (RIPPLE) ON DC	AT	ADJUST
1	100 mV rms	5 kHz	10 g pk	140 mV p-p ±14 mV	pin D Card D	HI Card D
2	100 mV rms	5 Hz	10 g pk	140 mV p-p ±14 mV	pin D Card D	LO Card D
	100 mV rms	100 Hz	10 g pk	140 mV p-p ±50 mV	pin D Card D	-
	510 mV rms	100 Hz	100 mil p-p	140 mV p-p ±50 mV	pin C Card D	-
	1.277mV rms	5 Hz	100 mil p-p	140 mV p-p ±50 mV	pin C Card D	-

Table 4.4 Tracking Low-Pass Filters

4.6 DIGITAL METER - SINE

With the settings in 4.4 and the input signals in Lines 1 and 2 of Table 4.3, check the indication of the digital meter. If necessary adjust the CAL and ZERO potentiometers on Card V (near front panel) for readings of 14.1 and 0.0 g pk respectively.

4.7 DIGITAL METER - RANDOM

With the settings in Lines 1 and 3 of Table 4.3 in Section 4.4 and the S/R SELECTOR switched to RANDOM (pushed IN), the indications on the DIGITAL METER should be 11.3 g rms and 57 mil rms respectively. (The ratio of readings for the RANDOM position and the SINE position of the S/R selector for sine inputs is .80 and .40 respectively for acceleration and displacement readings.)

4.8 LIMIT LEVELS

Set the ACC and DISP LIMIT LEVELS to 10.0 g pk and 100 mil p-p respectively. Apply an input signal at 100 Hz to VOLT IN. Press the RESET button to cause any OVERLIMIT indication to be reset.

Monitor ACCELERATION (A/D selector OUT) and increase input signal slowly from zero. On the DIGITAL METER note the level at which the ACCELERATION OVERLIMIT indicator lights. The indication should be 10.0 ±0.2 g pk.

Monitor DISPLACEMENT (A/D selector IN) and continue to increase input signal. Again note the level on the DIGITAL METER at which the DISP. OVERLIMIT indicator lights. The indication should be 100 ±3 mil p-p.

With the SHUTDOWN switch to the IN position an increase of about 10% above the ACCELERATION LIMIT causes RE 1 to change states. This relay provides a contact opening to remove power from the final stages of the system power amplifier.

The remaining sections describe procedures that generally do not have to be done periodically and functions of adjustment controls that have not been described in previous sections.

4.9 COMPRESSOR

4.9.1 Depress RESET (OVERLIMIT indicators go out)
Apply 1 V rms 100 Hz to R/S IN
Measure 1 V rms ±5% at R/S OUT
Adjust GAIN Card J if tolerance is not met.

4.9.2 Increase voltage at R/S input to 9 V rms. No clipping at R/S OUT should be noticed on the oscilloscope monitor.

4.9.3 Apply 1 V rms to R/S IN and OSC IN (same voltage)
voltage to VOLT. IN to trip ACC. OVERLIMIT

Set R/S SELECTOR for SINE (out)
SHUTDOWN to IN
Monitor Waveform envelope at R/S OUT with oscilloscope

Alternately depress and release the RESET button and observe the envelope on the oscilloscope. It should appear as shown in Fig. 4.2

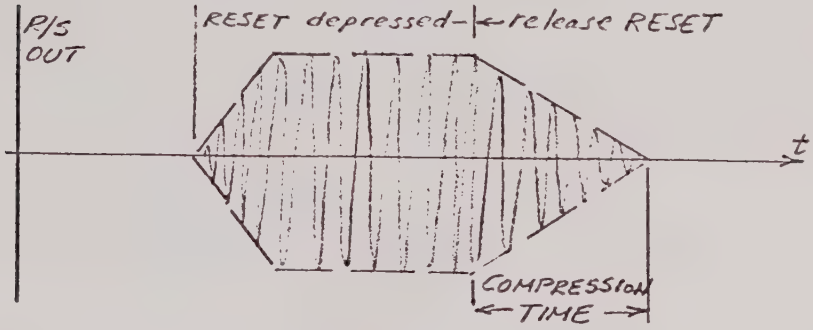


Fig. 4.2
R/S OUTPUT

When RESET is depressed and held, the voltage at R/S OUT increases linearly to the input level and remains constant. When the RESET button is released, the OVERLIMIT is immediately triggered and the voltage compresses linearly to zero. The compression time as labeled on Fig. 4.1 is a function of frequency. Measurements are given in Table 4.5.

FREQUENCY	LIN FREQ. INPUT	MEASURED COMP TIME
5 Hz	10 mV DC	500 ±200 msec
5 kHz	10 V DC	5 ±2 msec

Table 4.5 Compression Time

With the S/R SELECTOR set to RANDOM (in), the compression time is constant at 50 ±20 msec.

The compression time is controlled by the adjustments in 4.5. If the compression time is far out of tolerance, the matched set of VTL2C2's on Cards D and J may need to be replaced.

4.10 COMPRESSOR-BALANCE

Apply 0V to R/S IN
Monitor TP1 with oscilloscope
With OVERLIMIT condition, adj BAL LO for a null (0 V DC at TP1)
With no OVERLIMIT condition, adj BAL HI for a null.
Repeat the last two steps until there is a minimum transient as the OVERLIMIT condition is triggered and subsequently reset.

4.11 NULL ADJUSTMENT - AC-DC CONVERTERS

Provide the appropriate zero input signal condition given in line 2 or line 4 of Table 4.3 (Section 4.4). Repeat the adjustments in Table 4.6 sequentially.

MONITOR	ADJUST	MEASURE
ACC - TP1 Card C	BAL	0 V DC ±20 mV
DISP - TP1 Card E		
ACC - Pin D Card D	ZERO	0 V DC ±1 mV
DISP - Pin C Card D		

Table 4.6 Null Adjustment

4.12 MISCELLANEOUS ADJUSTMENTS

4.12.1 Card B BAL - Adjusted for approximately .2 V DC at Pin 6 of NE531V for a SENS setting of 1.0 pC/g.

4.12.2 Card H - ADJ 2V - Adjusted for 2.15 V DC at Pin J Card H.

4.12.3 Card K - DELAY - Adjusts delay between OVERLIMIT actuation and energizing of RE 1, which causes power amplifier shutdown. For 100 ms delay, the voltage at TP1 should be approximately -4.3 V. The delay is inversely proportional to this voltage.

4.13 VOLTAGE adjustment Card M

4.13.1
SHUTDOWN to BYPASS
Apply signal to R/S IN (100 Hz)
Measure voltage at R/S OUT
Depress RESET

4.13.2 Increase R/S IN voltage slowly until the LOW LIMIT light goes on. Record R/S OUT voltage.

4.13.3 RESET, and readjust VOLTAGE if necessary to change critical voltage level.

4.13.4 In Random mode, increase sinusoidal voltage to R/S IN slowly until the low limit light goes on. This level should be approximately twice SINE mode voltage.

4.14 LOW LIMIT adjustment Card M

4.14.1
SENSITIVITY to 10 pC/g
ACC RANGE to 10 g
SHUTDOWN to BYPASS
Apply approx. 2 V rms to R/S IN (100 Hz)
Apply approx. 100 mV rms to CAL INPUT
Push RESET

4.14.2 Decrease amplitude of signal applied to CAL INPUT slowly until the LOW LIMIT light goes on. Record the indicated value of acceleration on the digital meter.

4.14.3 Readjust LOW LIMIT, push RESET and repeat 4.14.1 and 4.14.2 if a different low limit is desired.

4.15 F-V CONVERTER ADJUSTMENT - CARD N

4.15.1 Apply approx. 1 V rms to OSC IN
Monitor LIN DC with DC DVM.

4.15.2 Set oscillator frequency at 5 kHz.
LIN DC output should be 10.0 ±0.1 V DC
Adjust HI if necessary.

4.15.3 Set oscillator frequency at 5 Hz. LIN DC output should be 10 ±1 mV DC. Adjust LO if necessary.

5. MAINTENANCE-SERVICING

5.1 Circuit Diagrams

The circuit diagrams and component layouts found in Section 6 should be used with signal tracing techniques to pinpoint any problems. The checkout and calibration procedures in Section 4 are valuable aids for locating problems.

5.2 Access for Servicing

Removing the top cover exposes all printed circuit cards and adjustment potentiometers, as well as all connector terminals. All cards except the digital voltmeter card (Card V) may be removed by pulling them out of the connectors. The DVM (Card V) may be removed by unsoldering the connecting wires from the terminals and removing the front panel screws. Removing the screws alone generally gives sufficient access for replacement of the display LED's.

ALL PRINTED CIRCUIT CARDS SHOULD BE REMOVED AND REPLACED WITH THE POWER OFF.

Some switch terminals are more accessible with the bottom cover removed.

5.3 LED Replacement

A front-panel mounted LED should be replaced by unsoldering the connecting wires and pushing it out from the rear. Do not use prying tools from the front, as these may scratch the panel. The new LED is inserted by pushing it in from the front with a blunt tool on the lens of the LED.

5.4 Power Supply Voltages

If trouble is suspected, the voltages associated with the power supplies should be measured first. The power supply voltages are found in the following table.

CARDS	PIN(S)	VOLTAGE	MAX RIPPLE
A, B, C, D, E F, H, J, K,M,P	10 to 6	+14.4 to +15.6 VDC	10 mV pp
A, B, C, D, E F, H, J, K,M,P	9 to 6	-14.4 to -15.6 VDC	10 mV pp
M,P	J to 6	+4.8 to +5.4 VDC	50 mV pp
V	4 to 3	+4.8 to +5.4 VDC	50 mV pp
P	D to 1 E to 1	22 to 28 V rms	N.A.
P	C to A B to A	9.5 to 12.5 V rms	N.A.
P	3 to 6	10 to 12 V DC	2 V pp

5.5 Component Replacement

Component replacement on a printed circuit card should be a rare occurrence, but the following instructions should be followed to prevent damage to the printed circuit.

Some integrated circuits are socket mounted, and may be replaced easily. Should a MC14435 require replacement, it is important that the handler be physically grounded to prevent static charges from damaging the unit.

Should a permanently mounted part require replacement, remove the excess solder at the points of insertion with a soldering iron and a desoldering wick (Dri-wick-American Electrical Heater Co.). On a single-sided board, the component can usually be lifted out with long-nose pliers. On a double-sided board with plated-true holes, however, it is necessary to heat each insertion point while pulling on the lead with pliers Take care not to delaminate the printed circuit conductors.

There are also specifically-shaped tools available with soldering irons for removing multi-pin devices from two-sided boards.

5.6 Component List

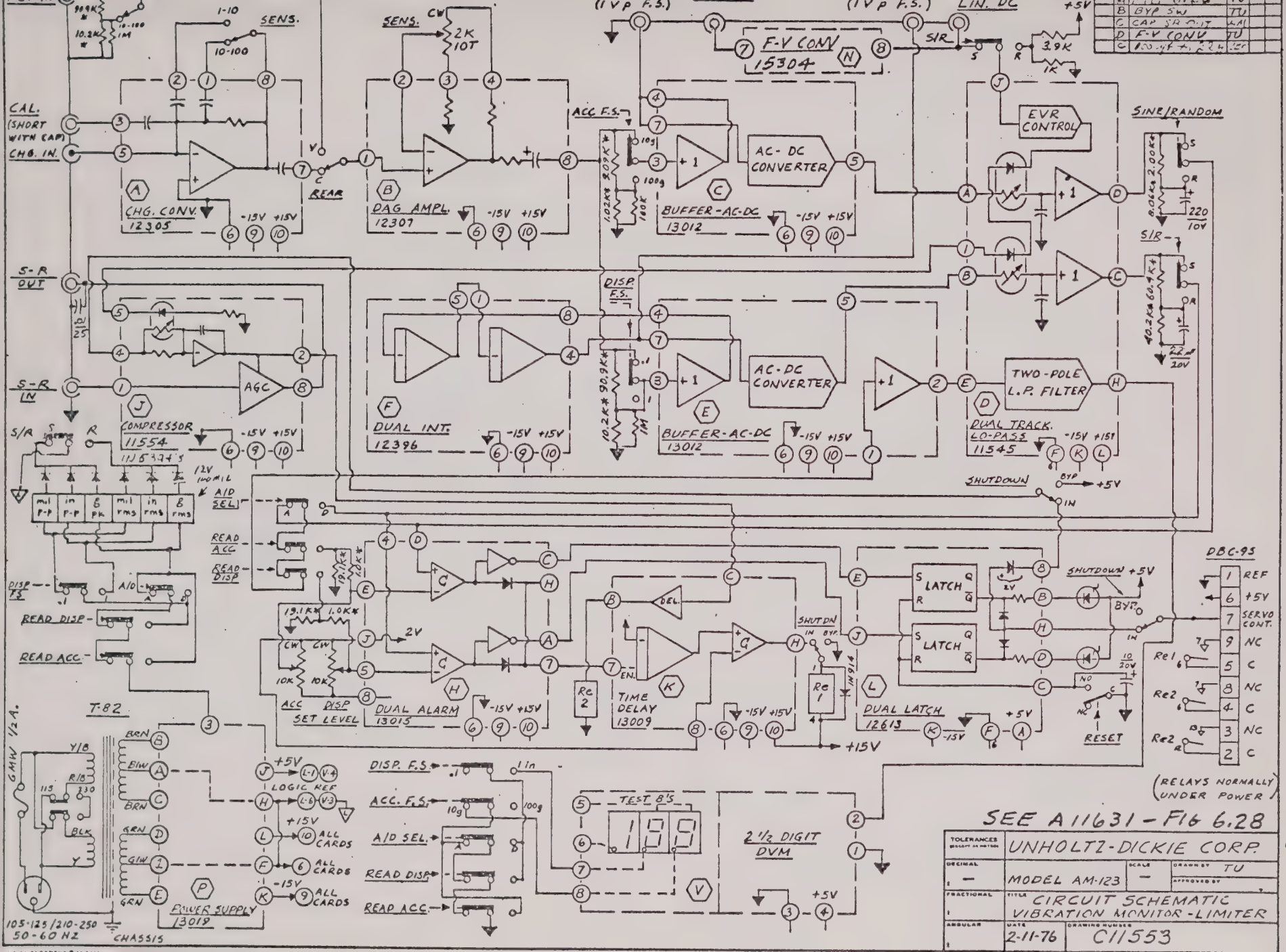
The following list gives ordering information for integrated circuits, semiconductors, and other critical components used in the Model AM-123. Other resistors and capacitors are widely available from many sources.

PART DESIGNATION	MANUFACTURER	DESCRIPTION
MC1505L	Motorola	A/D Converter Subsystem
MC14435FP	Motorola	3½ Digit A/D Subsystem
8T04B	Signetics	Seven Seg. Decoder/Driver
HP5082-7650	Hewlett-Packard	.43 in LED Display
MC7805CP	Motorola	+5 V Regulator
MC7815CP	Motorola	+15 V Regulator
MC7915 CP	Motorola	-15 V Regulator
2N 4401	Motorola	PNP
2N 4403	Motorola	NPN
AD842	Analog Devices	Low Noise Dual FET
NE531V	Signetics	High Slew Rate Op. Amp.
LM301AN	National Semi.	Op Amp
LM311N	National Semi	Comparator
AD540J	Analog Devices	FET Op. Amp.
MC3303P	Motorola	Quad Op. Amp.
MC1458CP1	Motorola	Dual Op. Amp.
AD812	Analog Devices	Low Offset Dual NPN
VTL2C2	VacTec	Electronically Variable Resistor-Matched Set from U-D
SN7437N	Texas Instruments	Hi Out Quad NAND Gate
MZ 2362	Motorola	2.1 V Diode
1N5394	Westinghouse	Power Diode
1N 100	Sylvania	Ge Diode
U1898E	Amelco-Teledyne	N-FET
1N914	Fairchild	Si Diode
400-2-001	LEDCO	Red LED lamp
5530 12V-100mA	International Electro Exchange	Incandescent lamp
1000 pF ±½%	General Inst/Miconics	Mica Cap
10000 pF ±½%	General Inst/Miconics	Mica Cap

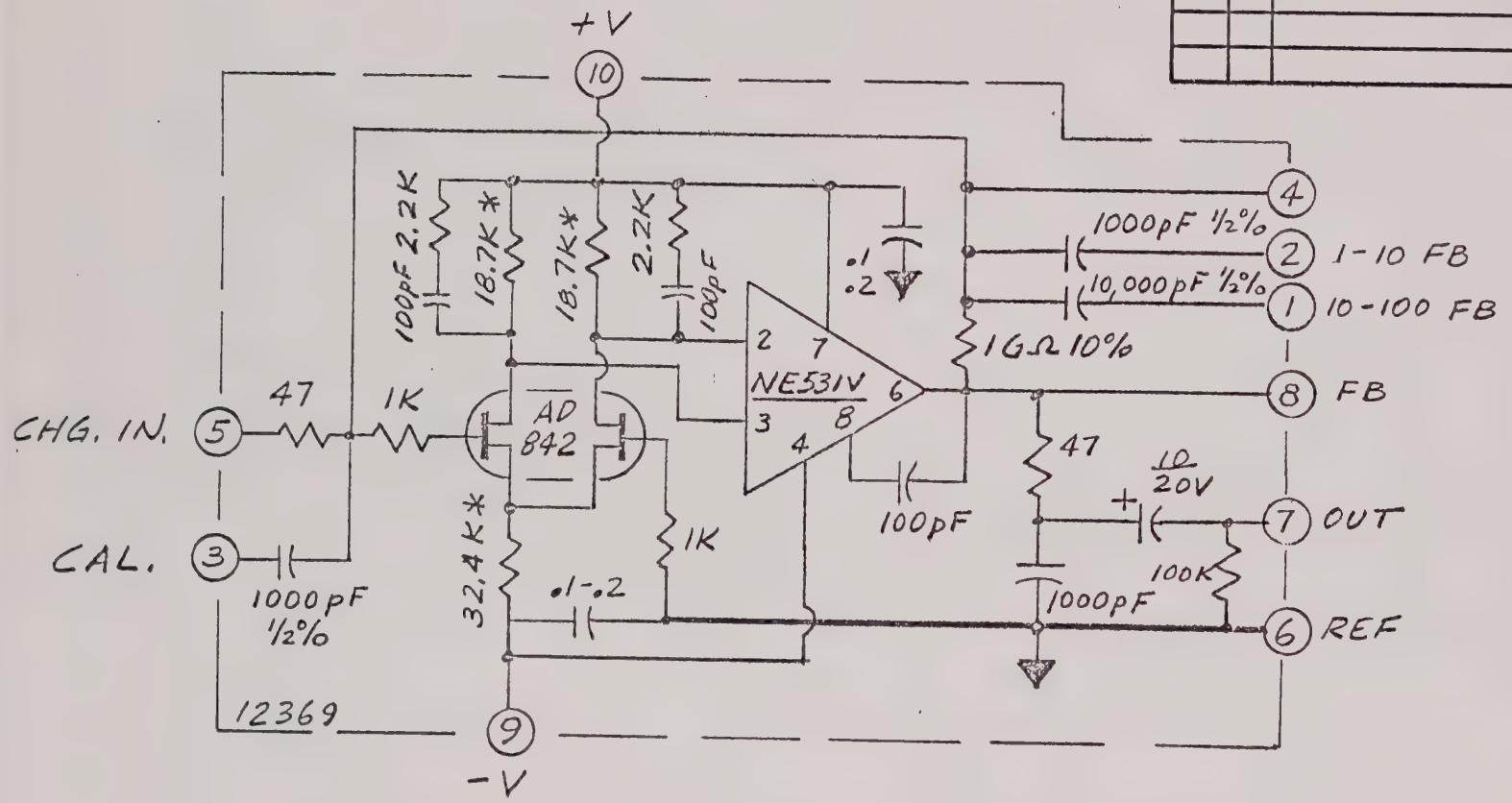
6. SCHEMATICS-LAYOUTS

Fig.	Title	Dwg. No.	Rev.
6.1	Instrument Circuit Schematic	C11553	E
6.2	Circuit - Charge Converter - A	A11558	NC
6.3	Layout - Charge Converter - A	A11557	NC
6.4	Circuit - Dial-A-Gain Amp. - B	A11580	NC
6.5	Layout - Dial-A-Gain Amp. - B	A11559	NC
6.6	Circuit - AC-DC Converter - C,E	A11582	NC
6.7	Layout - AC-DC Converter - C,E	A11581	NC
6.8	Circuit - Dual Track L.P.F.- D	A11547	NC
6.9	Layout - Dual Track L.P.F. - D	C11546	NC
6.10	Circuit - Dual Integrators - F	A11590	NC
6.11	Layout - Dual Integrators - F	A11589	NC
6.12	Circuit - Dual Alarm - H	A11584	NC
6.13	Layout - Dual Alarm - H	C11583	NC
6.14	Circuit - Compressor - J	A11556	A
6.15	Layout - Compressor - J	C11555	A
6.16	Circuit - Time Delay - K	A11586	NC
6.17	Layout - Time Delay - K	A11585	NC
6.18	Circuit - Dual Latch - L	A11588	A
6.19	Layout - Dual Latch - L	A11587	A
6.20	Circuit - Power Supply - P	A13033	NC
6.21	Layout - Power Supply - P	C13019	NC
6.22	Circuit - DVM - V	B13008	NC
6.23	Layout - DVM - V	C13007	NC
6.24	Circuit Low Limit - M	A11629	NC
6.25	Layout Low Limit - M	A11630	NC
6.26	Circuit - F-V Converter - N	B15306	NC
6.27	Layout - F-V Converter - N	C15305	NC
6.28	Circuit additions Low Limit Feature	A11631	A

Rev. 4/11/77
1/6/78


CAL. (SHORT WITH CAP)
CHG. IN.
CHG. CONV. 12305
SENS.
1-10
10-100
REAR
DAG AMPL. 12307
2K 10T
ACC F.S.
AC-DC CONVERTER
BUFFER-AC-DC 13012
F-V CONV 15304
LIN. DC
S/R
EVR CONTROL
SINE/RANDOM
S-R OUT
S-R IN
AGC
COMPRESSOR 11554
DUAL INT. 12396
DISP F.S.
TWO-POLE L.P. FILTER
DUAL TRACK LO-PASS 11545
SHUTDOWN
BYP
+5V
READ ACC
READ DISP
A/D SEL
DUAL ALARM 13015
ACC DISP SET LEVEL
TIME DELAY 13009
DUAL LATCH 12613
LATCH
RESET
DBC-95
REF
SERVO CONT.
NC
Re1
Re2
(RELAYS NORMALLY UNDER POWER)
T-82
POWER SUPPLY 13019
105-125/210-250 50-60 HZ
CHASSIS
LOGIC REF
ALL CARDS
TEST B'S
2 1/2 DIGIT DVM
SEE A11631 - FIG 6.28
UNHOLTZ-DICKIE CORP.
MODEL AM-123
CIRCUIT SCHEMATIC VIBRATION MONITOR-LIMITER
2-11-76
C11553

DATE	SYM	REVISION RECORD	AUTH	DR.	CK.



TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	MOD AM123	SCALE —	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC CHARGE CONVERTER		
ANGULAR ±	DATE 4-2-76	DRAWING NUMBER A11558	

A

FIG. 6.2

W.E. ALBA... IE ® 10 5465

MOD AM-123

TOLERANCES (UNLESS NOTED)	UNHOLTZ - DICKIE CORP	
MATERIAL		SCALE 2X
PROPRIETARY	TITLE COMPONENT LAYOUT CHARGE CONVERTER	
DATE		

A

FIG 6.3

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.

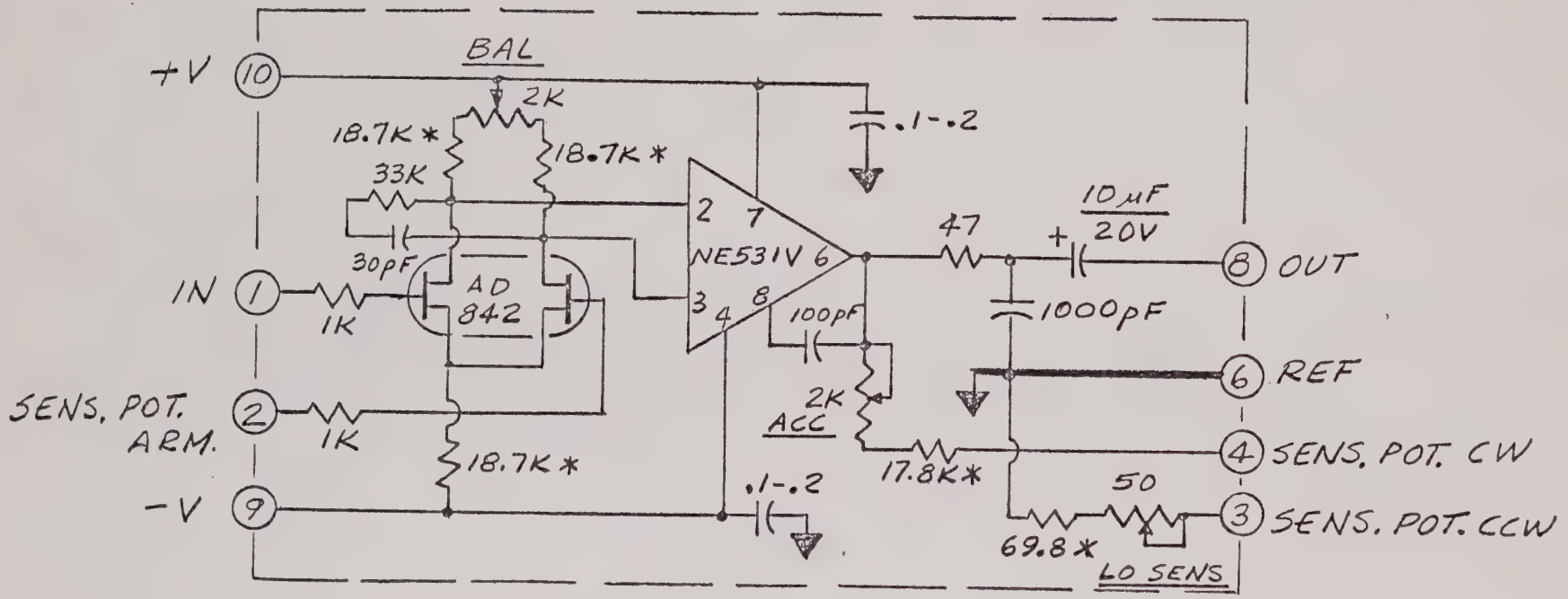


FIG. 6.4

B

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	MOD. AM123	SCALE —	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC DIAL-A-GAIN AMPL.		
ANGULAR ±	DATE 4-2-76	DRAWING NUMBER A11580	

K•E ALBANY - © 10 5465
ENGINEERED STANDARD FORM

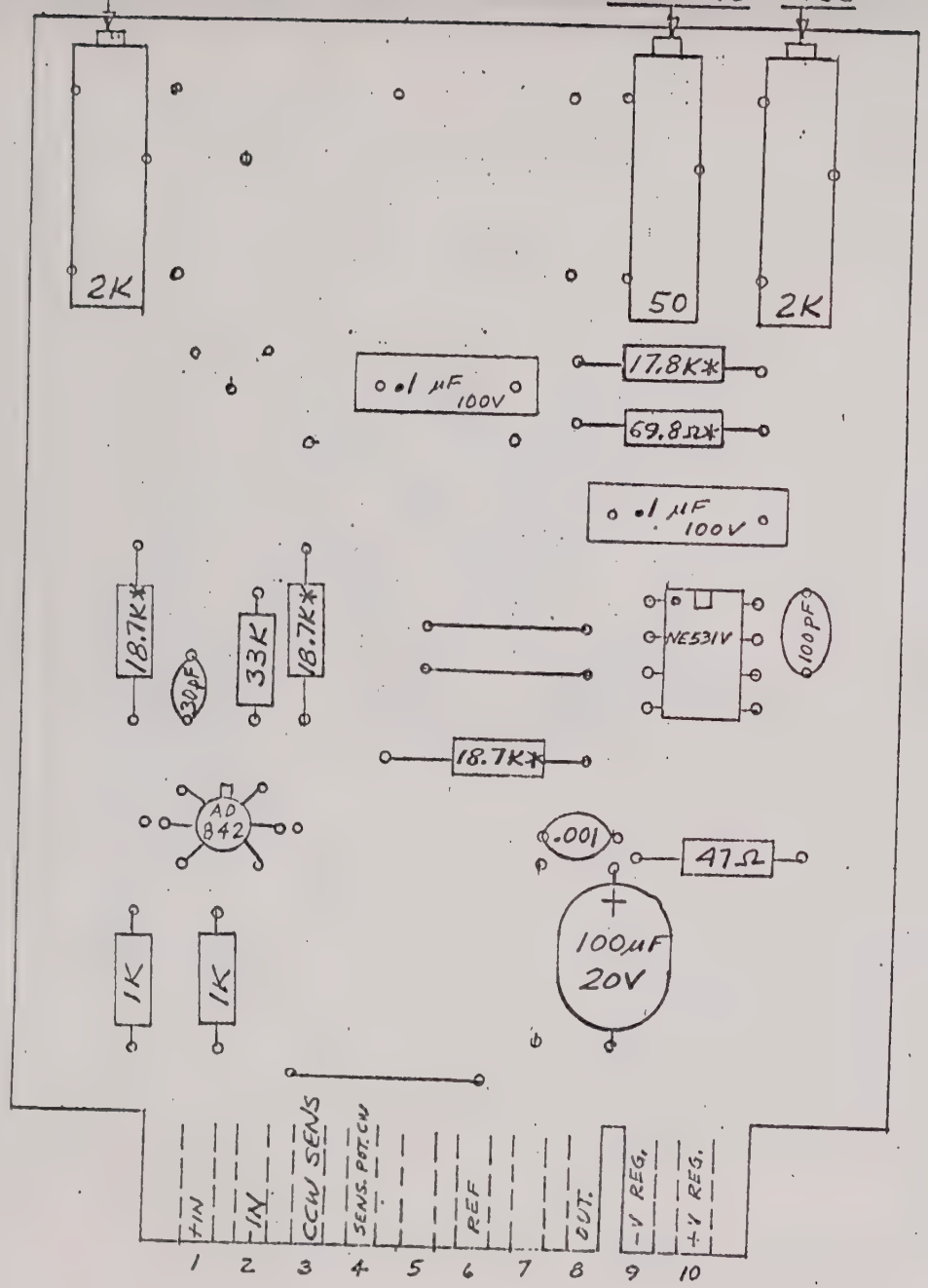


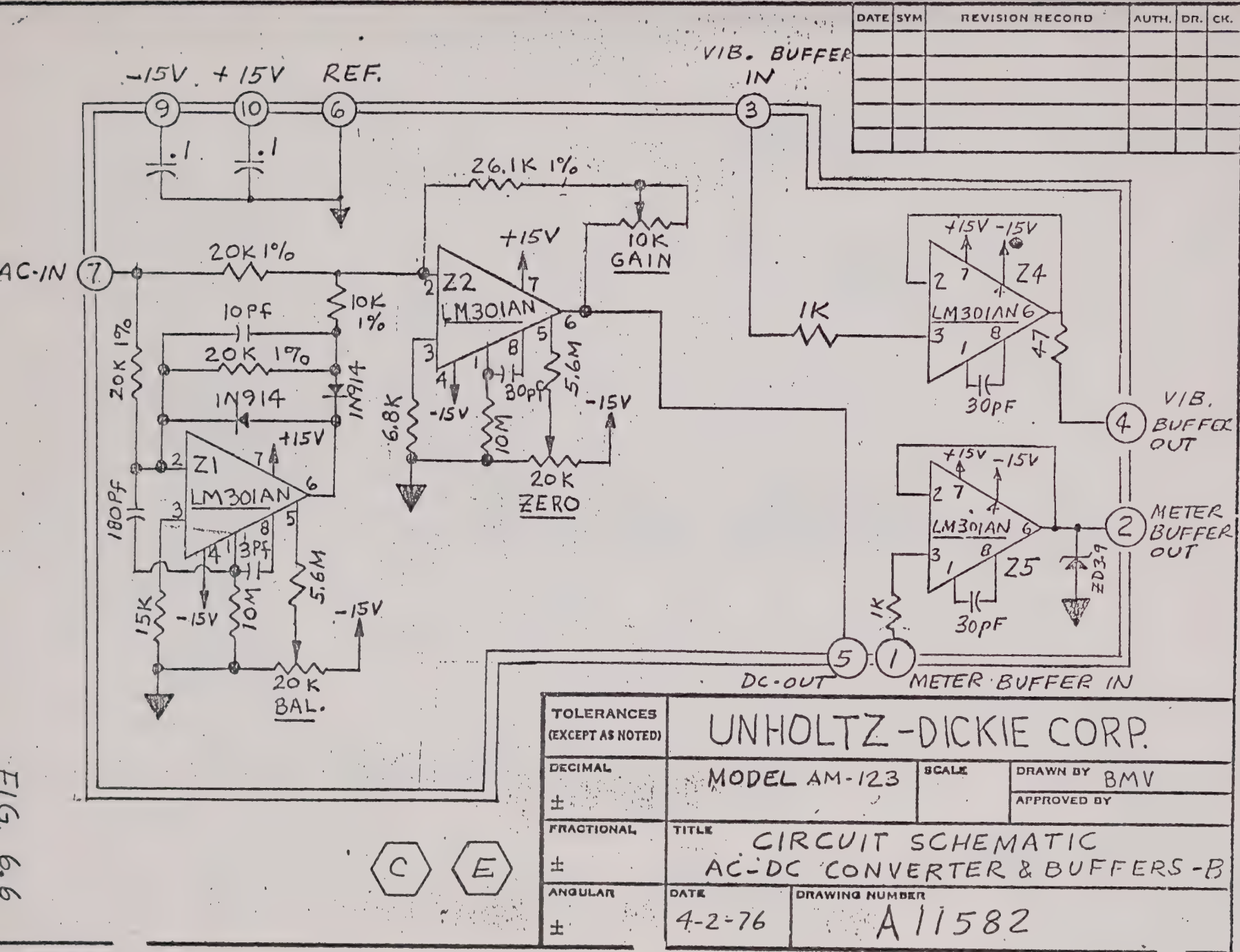
Fig. 6.5

B

MOD AM-123

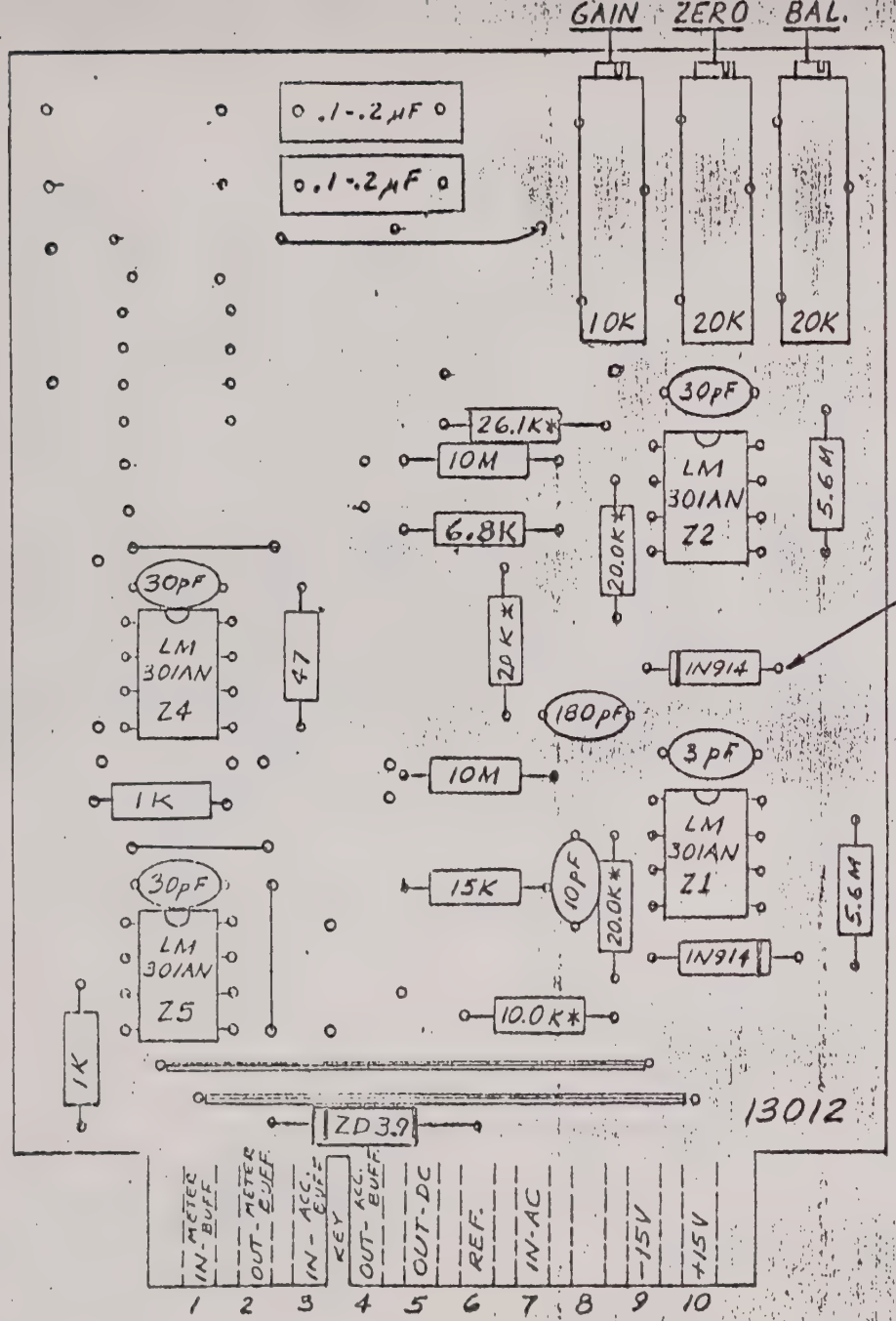
* 1% MET. FILM

TOLERANCES	UNIVOLT-DICKIE CORP.
ORIGINAL	SCALE — DRAWN BY TU
FRACTIONAL	TITLE: DIAL-A-GAIN AMPLIFIER COMPONENT LAYOUT
ANGULAR	DATE 4/2/74 — DRAWING NUMBER AU559



DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	MODEL AM-123	SCALE	DRAWN BY BMV APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC AC-DC CONVERTER & BUFFERS-B		
ANGULAR ±	DATE 4-2-76	DRAWING NUMBER A11582	



AM-123

U-D CORP

TITLE COMPONENT LAYOUT AC-DC CONV. & BUFFERS-B

4-2-76 A11581

FIG. 6.7

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.

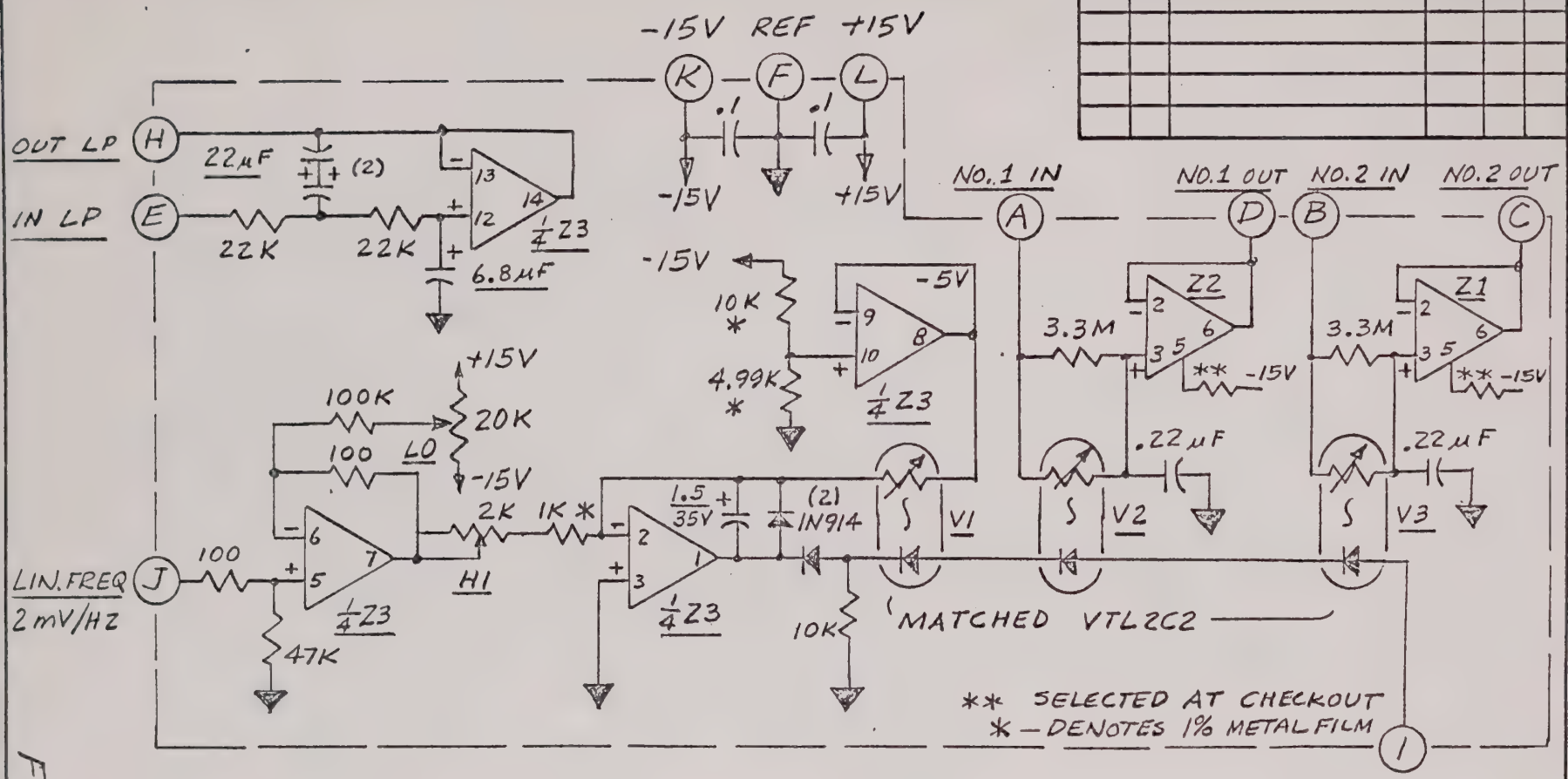


FIG. 6.8

C

PINS

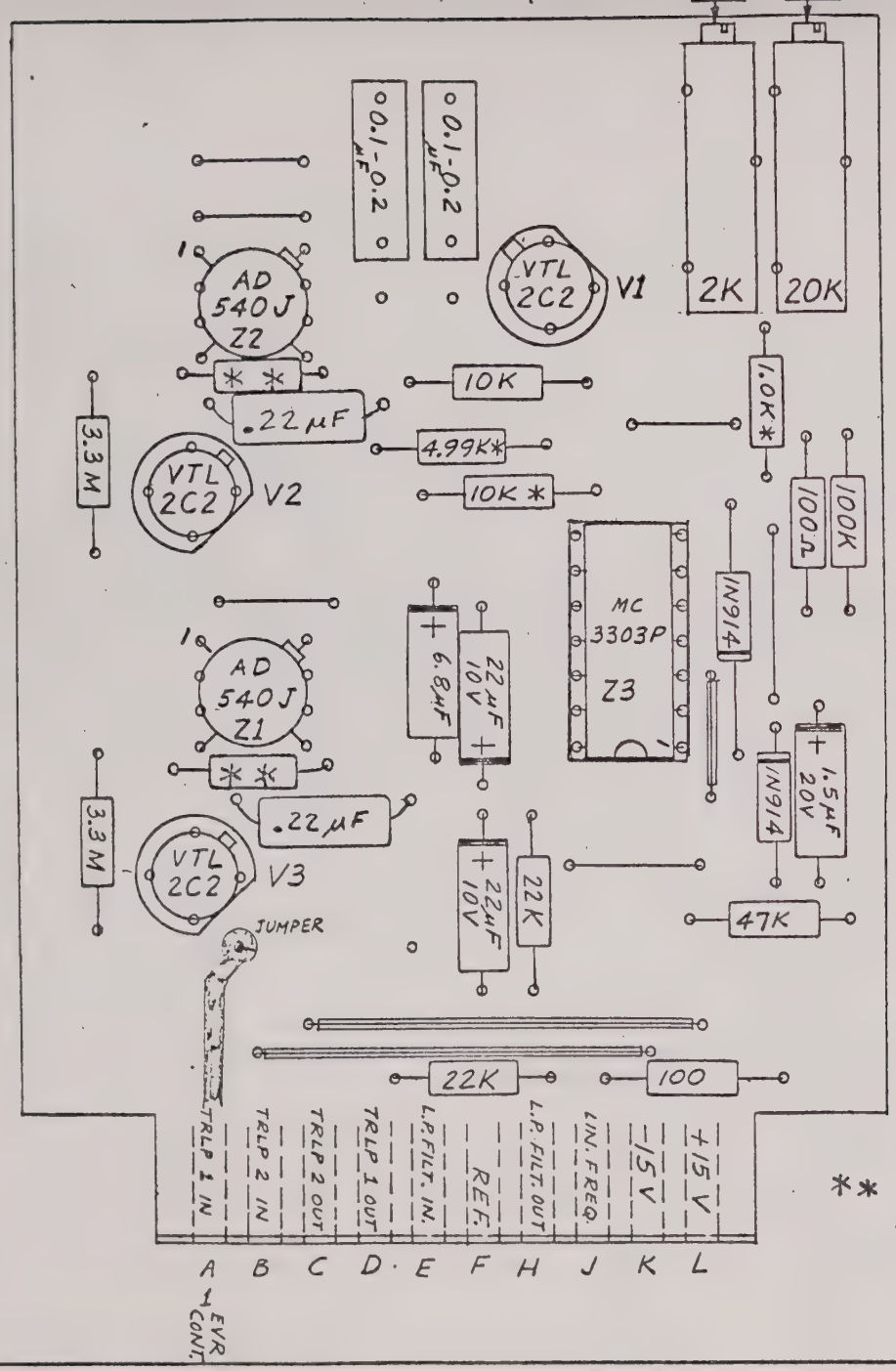
DES.	TYPE	+15V	-15V
Z1, Z2	AD540J	4	11
Z3	MC3303P	7	4

D

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ± —	AM123	SCALE —	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC DUAL TRACKING AVGR + L.P. FILTER		
ANGULAR ±	DATE 2/4/76	DRAWING NUMBER A11547	

K+E ALBANENE J 10 5465

MADE IN U.S.A.



** SELECTED AT CHECKOUT

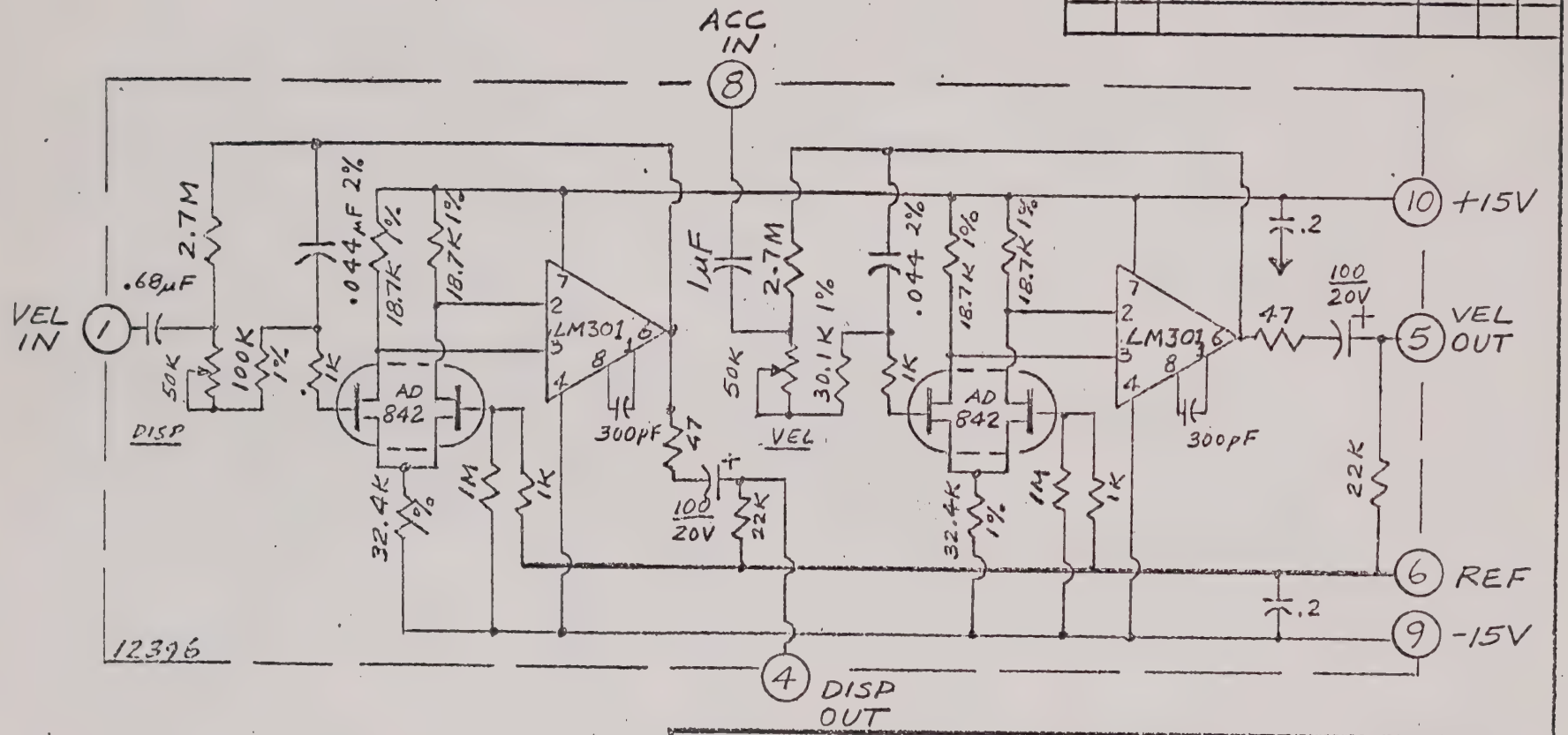
FIG. 6.9

D

MOD AM-123

TOLERANCES	UNHOLTZ-DICKIE CORP.		
DECIMAL		SCALE	DRAWN BY TU
			APPROVED BY
FRACTIONAL	TITLE COMPONENT LAYOUT TRACKING AVGR & LP FILTER		
ANGULAR	DATE 2/4/76	DRAWING NUMBER C11546	

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
4/7		S/N 117 UP	TU		



TOLERANCES (EXCEPT AS NOTED)	UNIHOLTZ-DICKIE CORP.		
DECIMAL ±	MOD AM-123	SCALE —	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC VEL. & DISP. INTEGRATORS		
ANGULAR ±	DATE 4-2-76	DRAWING NUMBER A 11590	

F

FIG. 6.10

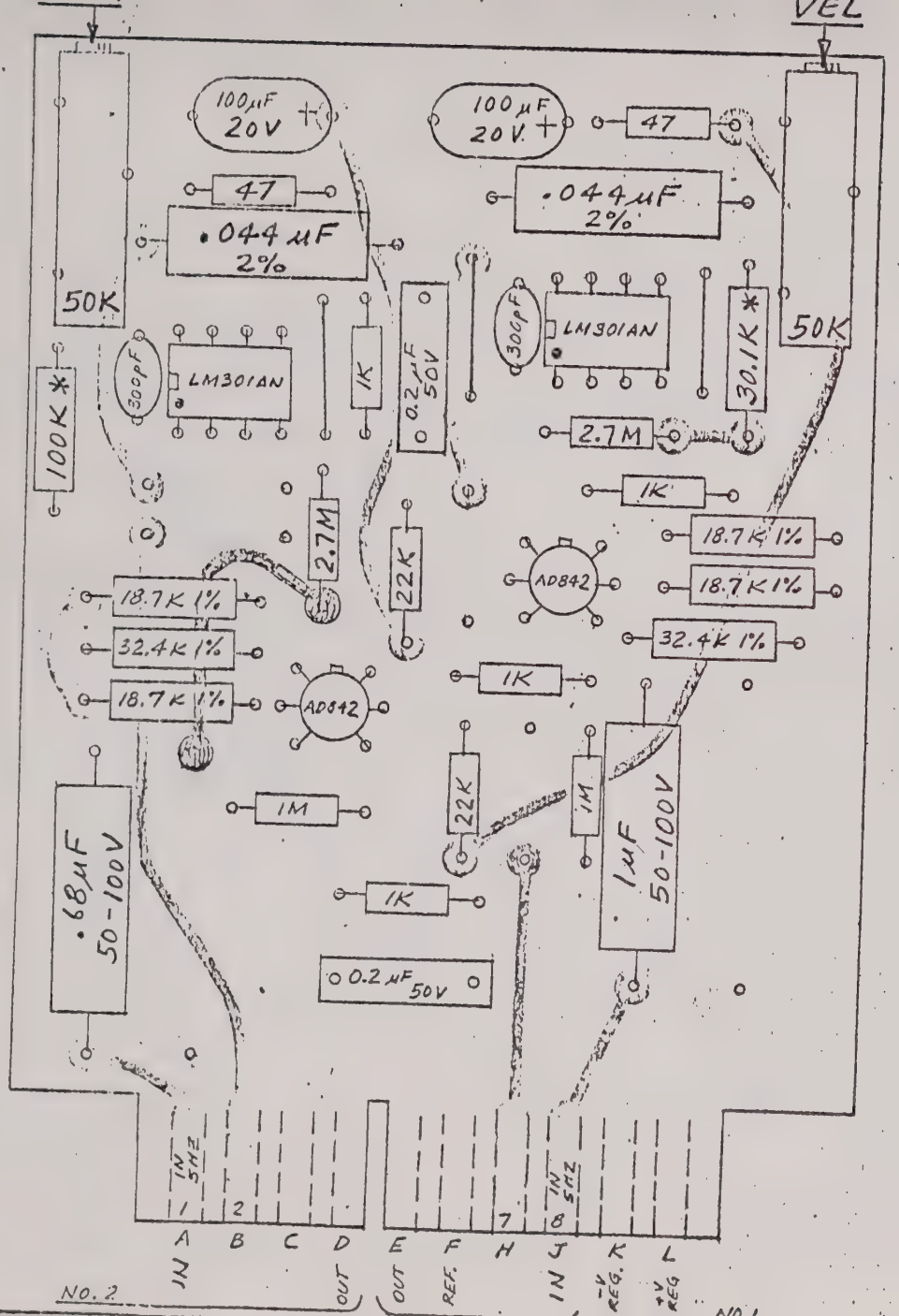


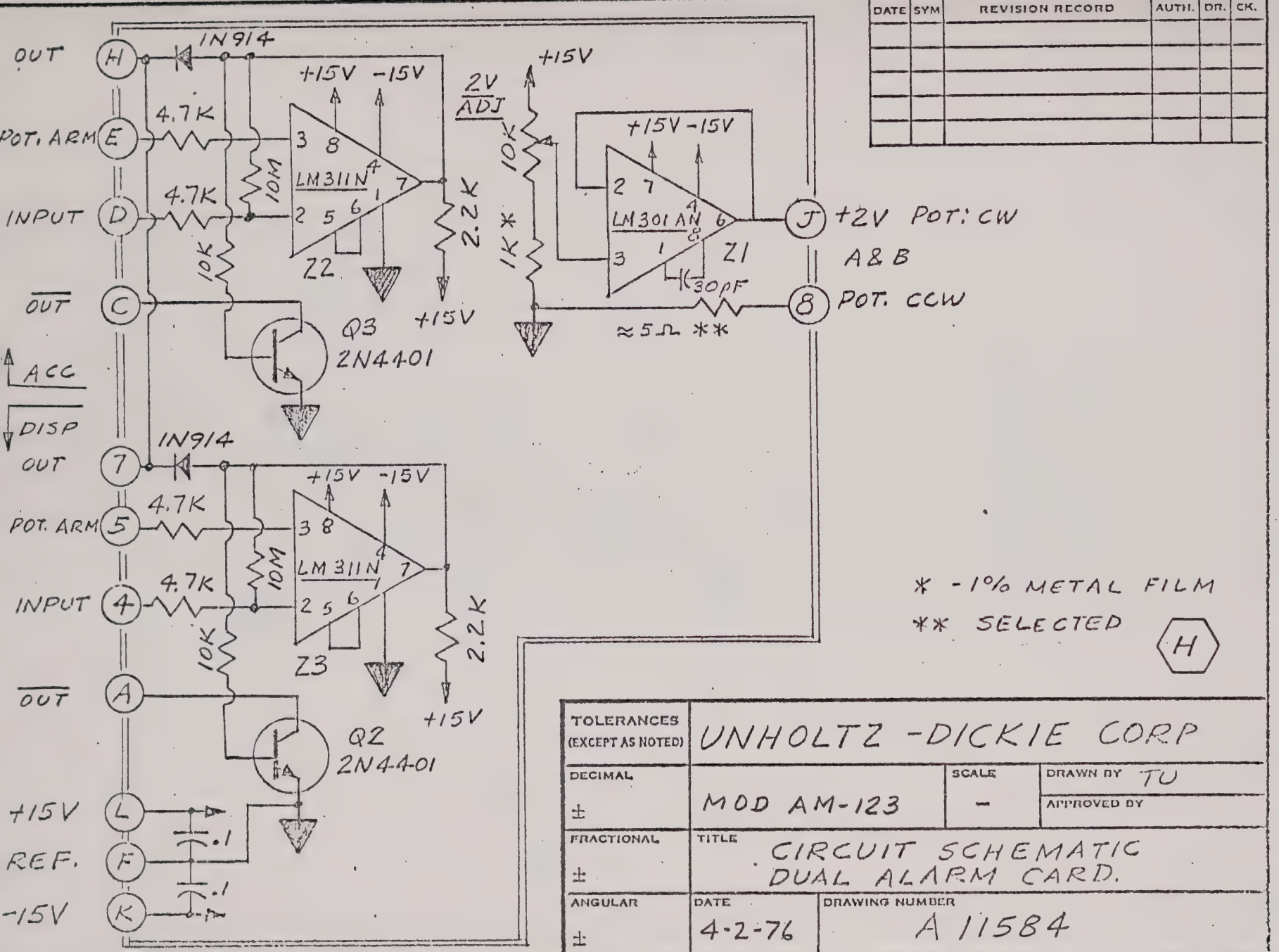
FIG. 6.11

* - 1% MET. FILM

F

	UNIHOLTZ-DICKIE CORP.
	MOD AM123 TU
	COMPONENT LAYOUT DUAL INTEGRATOR

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



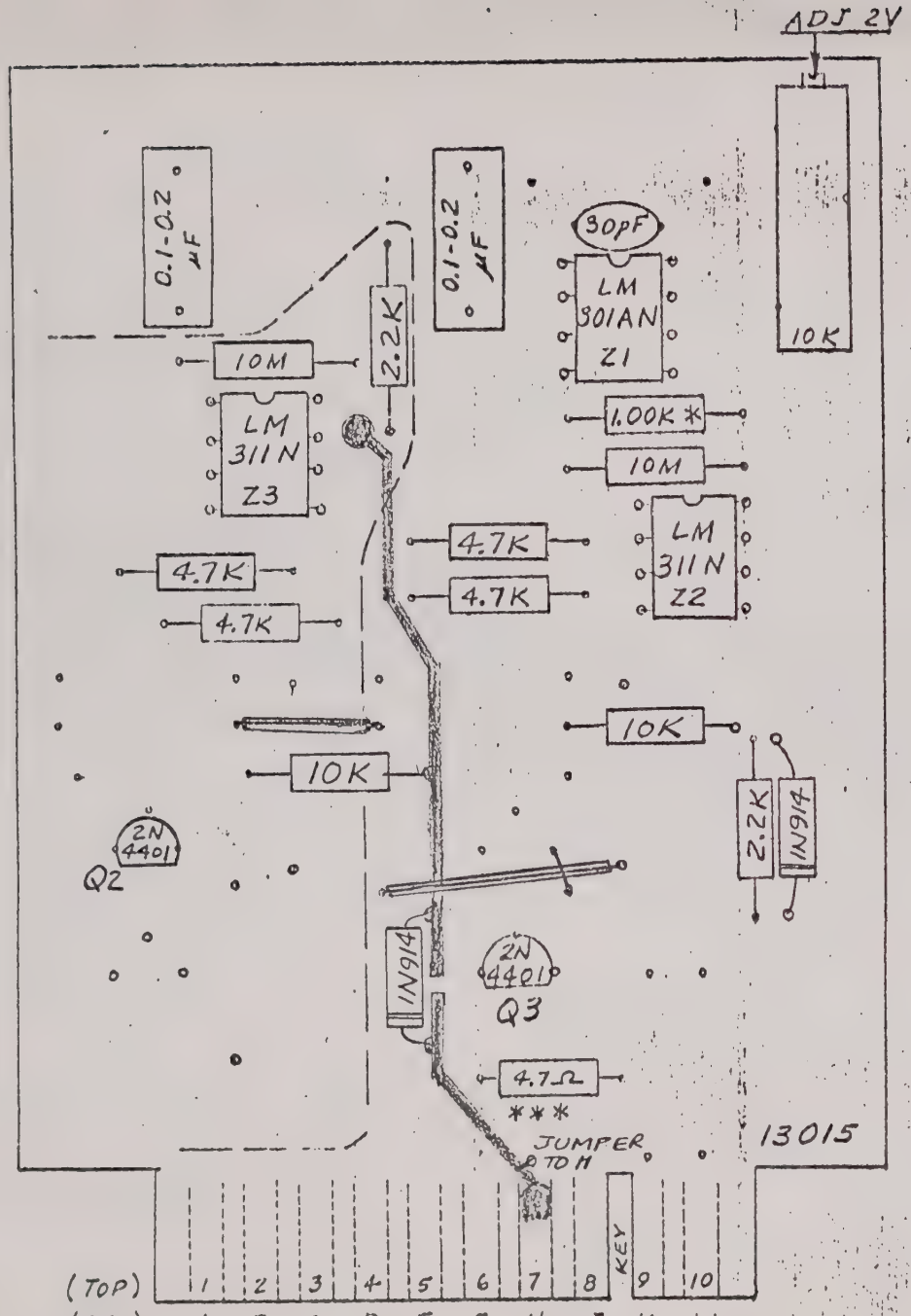
* - 1% METAL FILM

** SELECTED

H

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ - DICKIE CORP		
DECIMAL ±	MOD AM-123	SCALE -	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC DUAL ALARM CARD.		
ANGULAR ±	DATE 4-2-76	DRAWING NUMBER A 11584	

KOLOR CRYSTALENE ® 65 ... U.S.A.



TERM	FUNCTION	TERM	FUNCTION
A	DISP ALARM-$\bar{Q}$	1	
B		2	
C	ACC. ALARM $\bar{Q}$	3	
D	INPUT - ACC	4	INPUT - DISP
E	AL. LEV POT ARM-A	5	AL. LEV. POT ARM D
F	REFERENCE	6	—
H	ALARM OUT D/A	7	ALARM OUT D/A
J	AL. LEV. POT CW-	8	AL. LEV. POT. CCW
K	-15V REG.	9	—
L	+15V REG.	10	—

* - 1% METAL FILM

** { JUMPER - INHIBIT
2.49K, 1% - REDUCES GAIN BY 3.

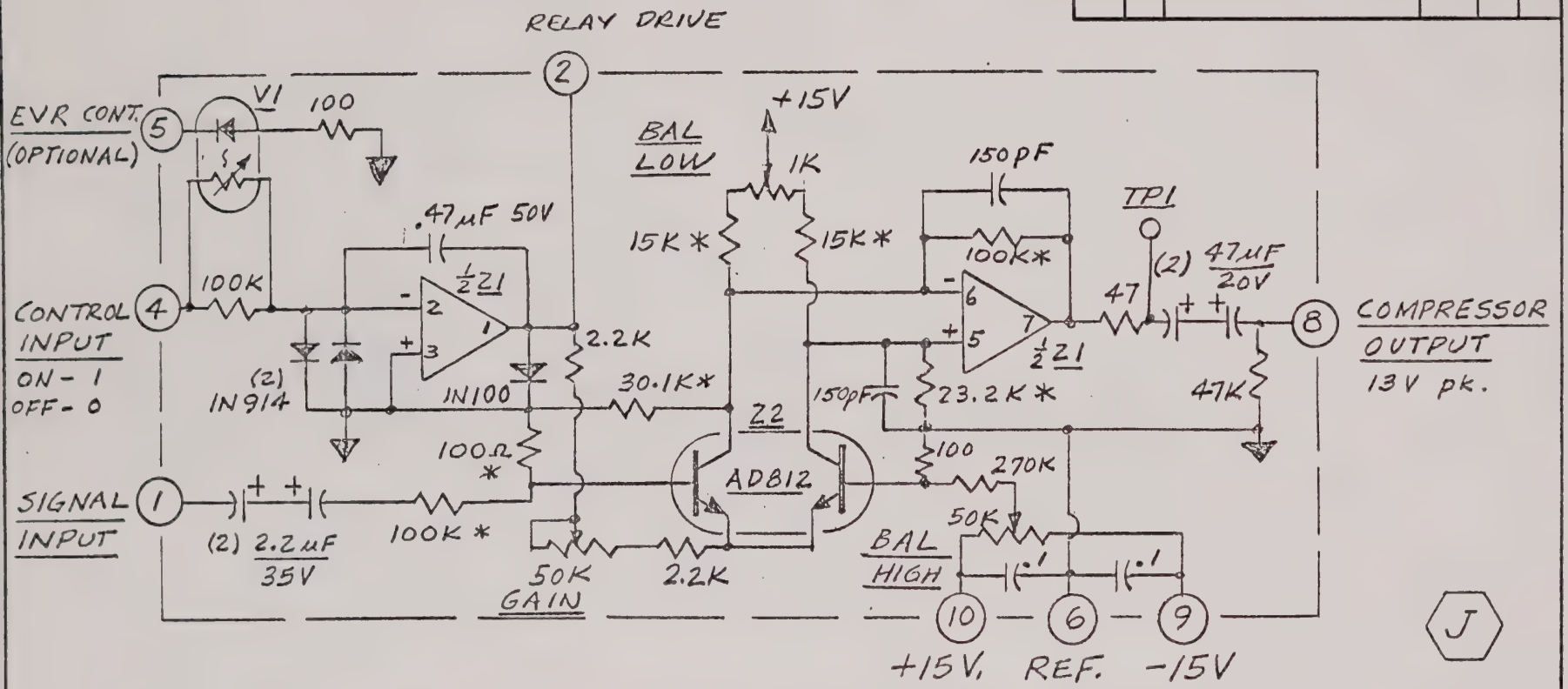
*** SELECTED ≈5Ω

TOLERANCES UNLESS OTHERWISE NOTED	UNHOLTZ-DICKIE CORP.
DECIMAL ±	SCALE — DRAWN BY TU
FRACTIONAL ±	TITLE COMPONENT LAYOUT DUAL ALARM CARD-
ANGULAR	DATE 4-2-76 DRAWING NUMBER A 11583

H

FIG. 6.13

DATE	SYM	REVISION RECORD	AUTH	DR.	CK.
12/77	A	30 → 150pf on Z1	LM		



Z1 - MC1458CP1 PIN 8 +15V
PIN 4 -15V

* - DENOTES 1% METAL FILM

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP		
DECIMAL ± -	AM-123	SCALE -	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC COMPRESSOR		
ANGULAR ±	DATE 2-17-76	DRAWING NUMBER A11556	

E

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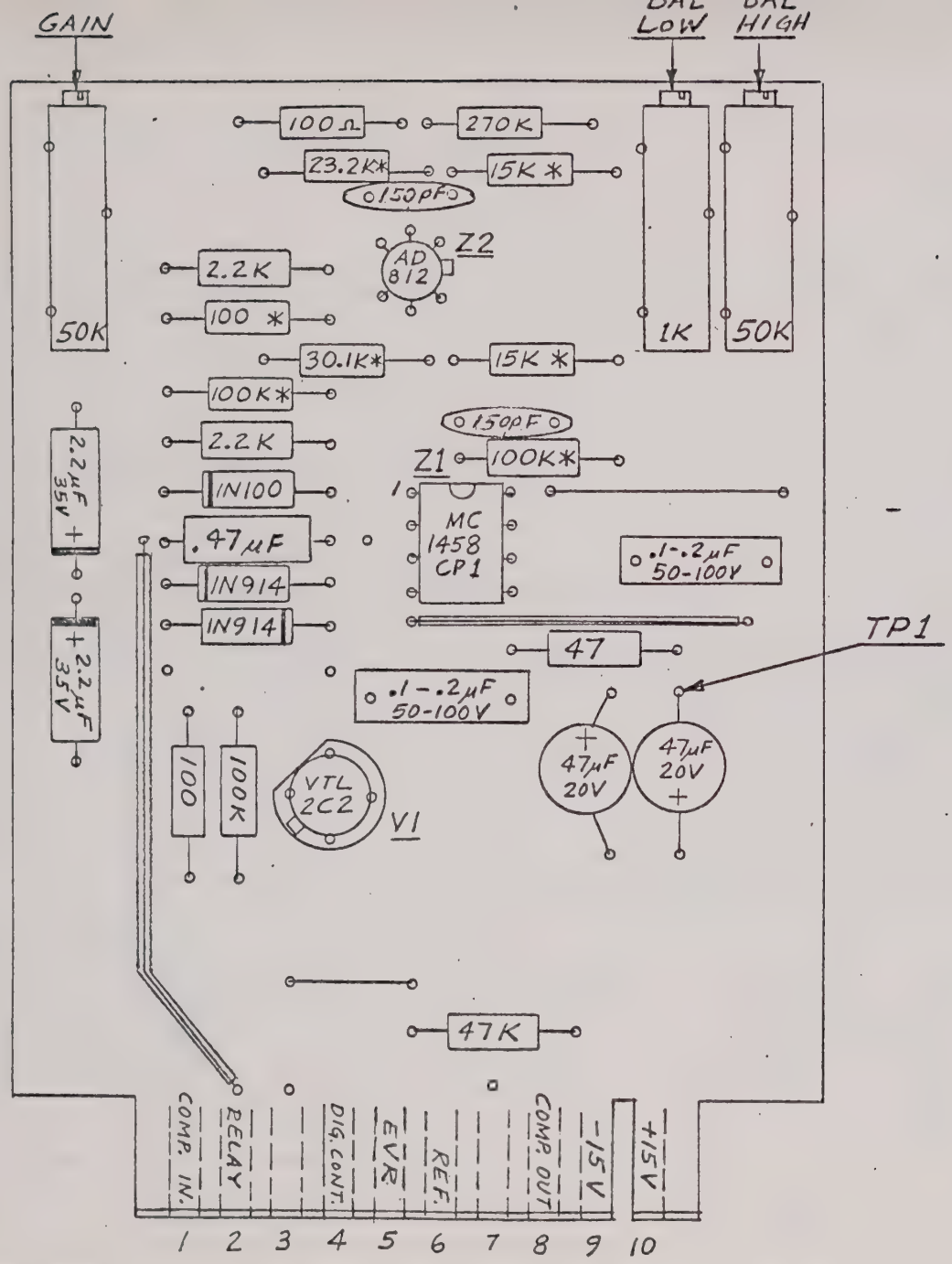
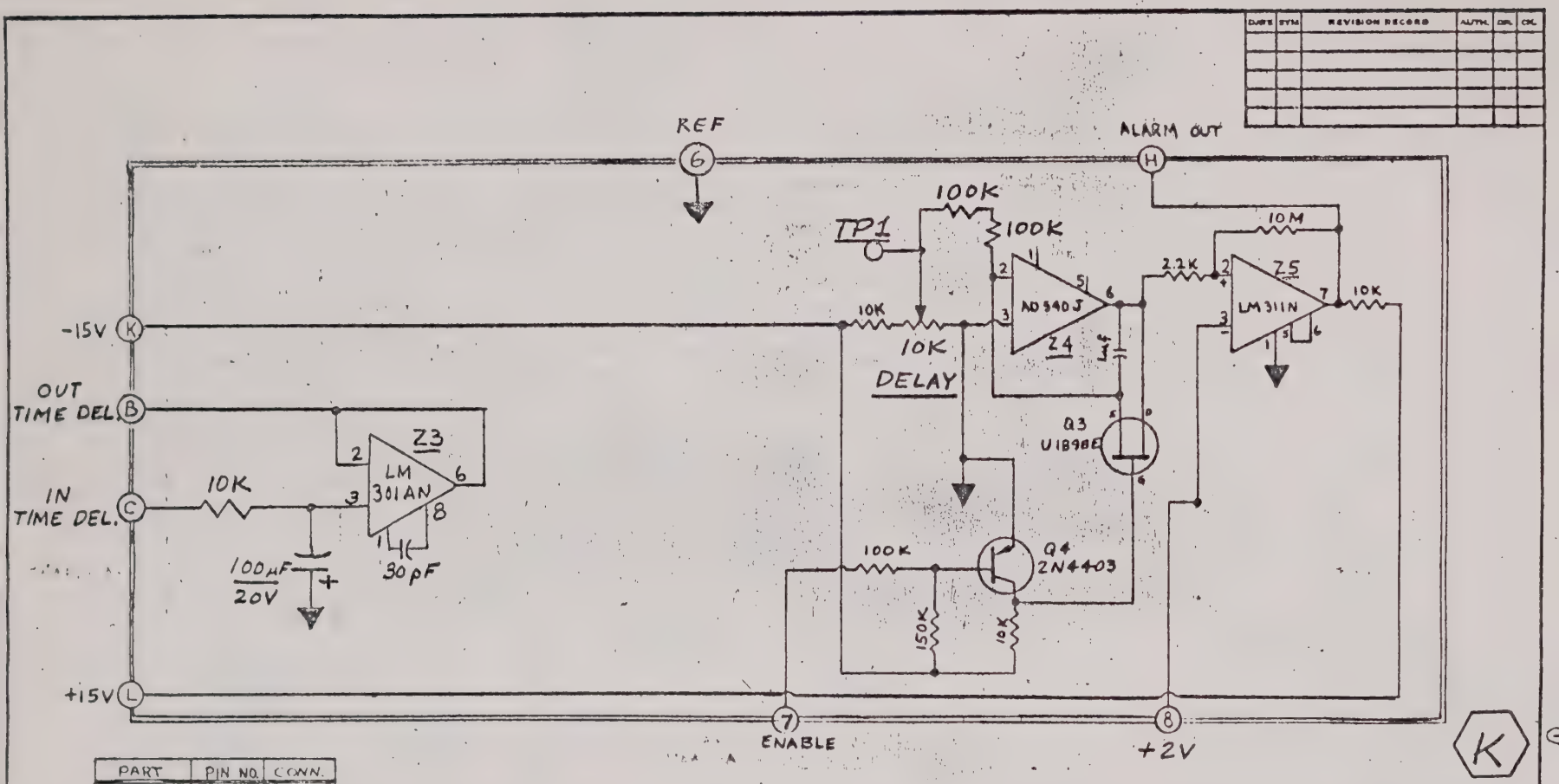


FIG. 6.15

J

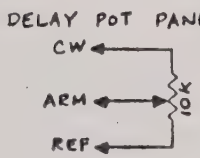
MOD. AM123

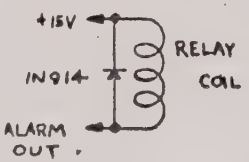
TOLERANCES UNLESS OTHERWISE NOTED	UNHOLTZ-DICKIE CORP.		
DECIMAL ± —		SCALE	DRAWN BY TU
			APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT COMPRESSOR CARD		
ANGULAR ±	DATE 2-13-76	DRAWING NUMBER C11555	



PART	PIN NO.	CONN.
Z3, Z4	7	+15V
	4	-15V
Z5	8	+15V
	4	-15V
	1	REF

*-DENOTES 1% METAL FILM





TOLERANCES EXCEPT AS NOTED	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	MOD AM-123	SCALE -	DRAWN BY BMV APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC - TIME DELAY CARD		
ANGULAR ±	DATE 4-2-76	DRAWING NUMBER A11586	

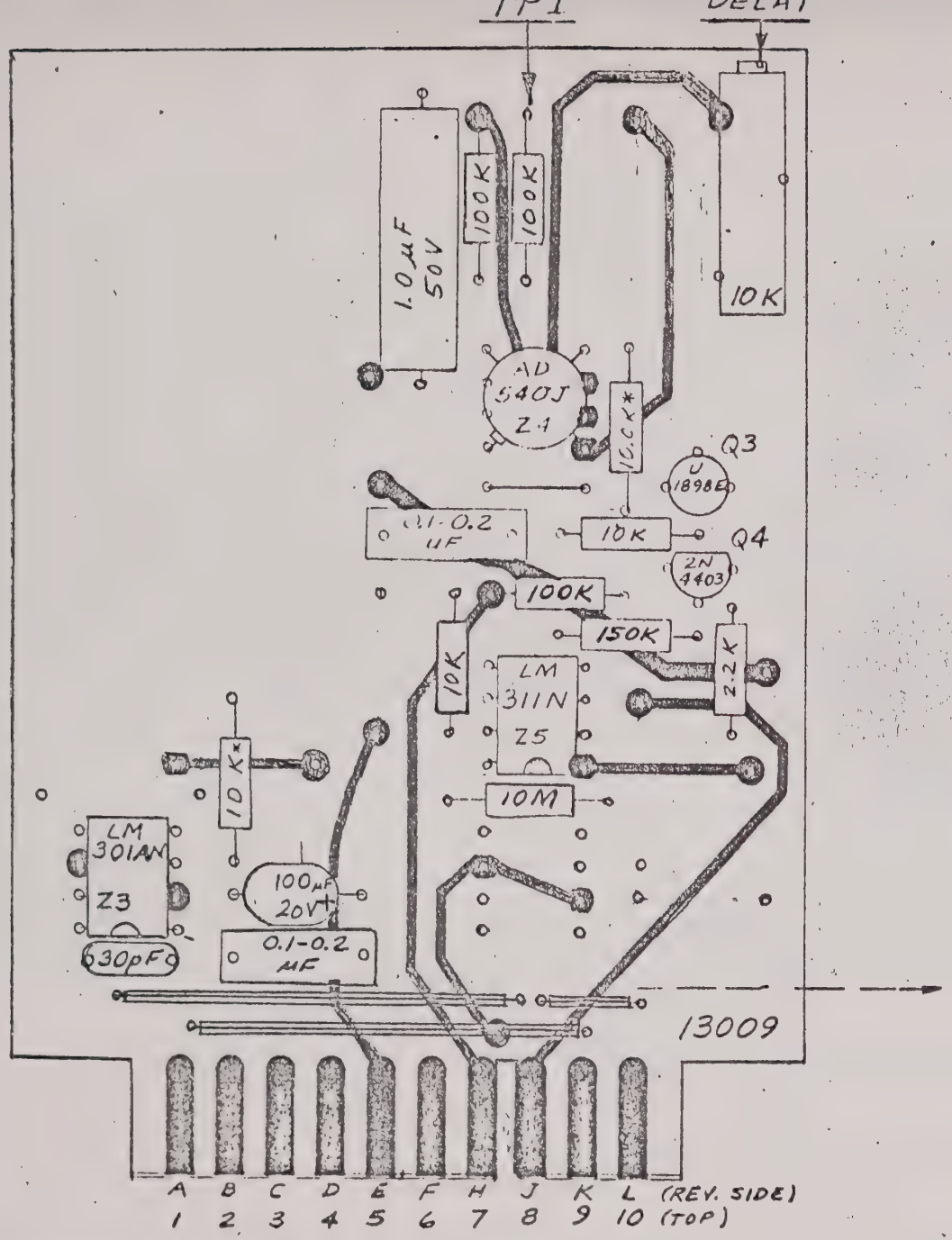


FIG. 6.17

K

TERMINAL FUNCTIONS

1		A	
2		B	OUT TIME DELAY
3		C	IN TIME DELAY
4		D	
5		E	
6		F	SIG. REF.
7	B-DELAY ENABLE	H	B-ALARM. OUT
8	B- DEL. POT ARM	J	
9		K	- 15V
10		L	+ 15V

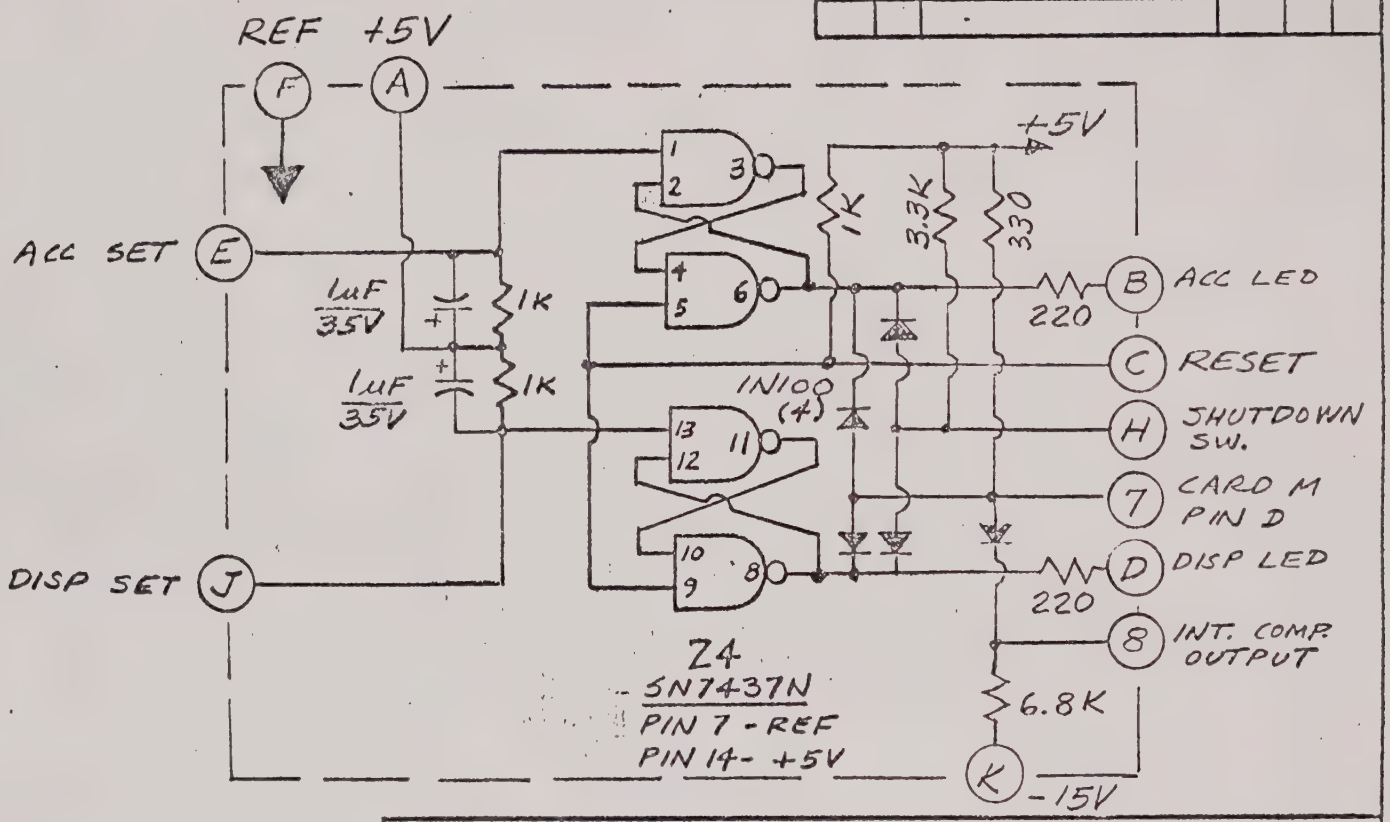
UNHOLTZ-DICKIE CORP.

MOD. AM-123 TU

COMPONENT LAYOUT
DUAL TIME DELAY CARD

9-16-75 A11585

DATE	SYM	REVISION RECORD	AUTH	DR.	CK.
4-77	A	PIN 7 SN 111-UP	TU		



L

E

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ± —		SCALE —	DRAWN BY TU
			APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC DUAL LATCH CARD		
ANGULAR ±	DATE 4-2-76	DRAWING NUMBER A 11588	

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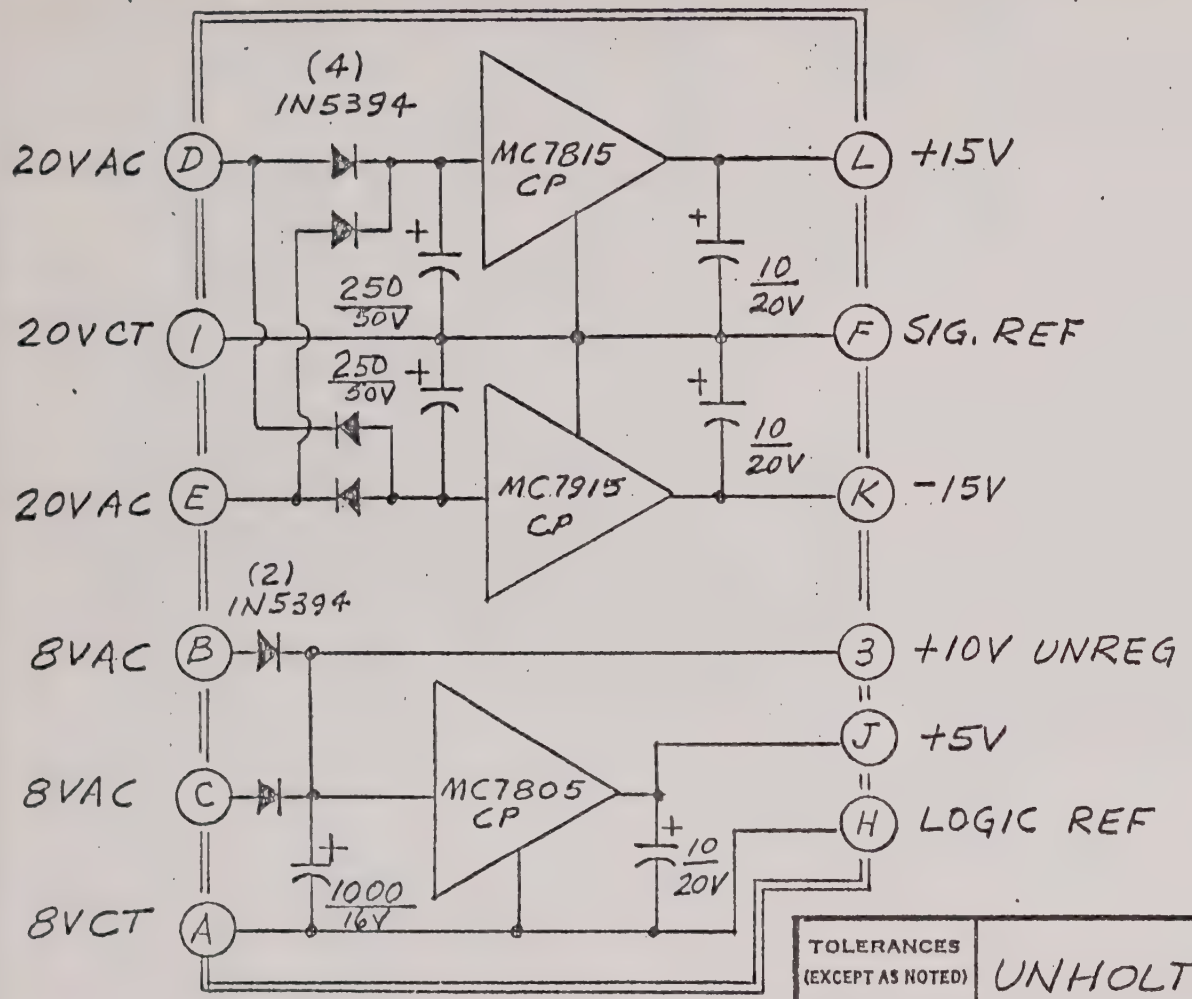
UNHOLTZ-DICKIE CORP.
MOD AM-123
COMPONENT LAYOUT
DUAL LATCH CARD
4-2-76
A115587
+5V REG.
A-ALARM
RESET
D-ALARM OUT
A-SET
REF.
EXT SERV
KEY
D-SET
-15V REG
+15V REG
B-INT COMP.
7 INT. SHUT
6.8K
3.3K
220
1K
220
1K
1K
330
74374N
1N100
1N100
1N100
1N100
1μf35V
1μf35V
2N2362
A
B
C
D
E
F
H
J
K
L

FIG. 6.19

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



P

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	MOD AM-123	SCALE	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC P- REGULATED POWER SUPPLY		
ANGULAR ±	DATE 11-15-75	DRAWING NUMBER A13033	

FIG. 6.20

M&E CRYSTALEN. 10 5485

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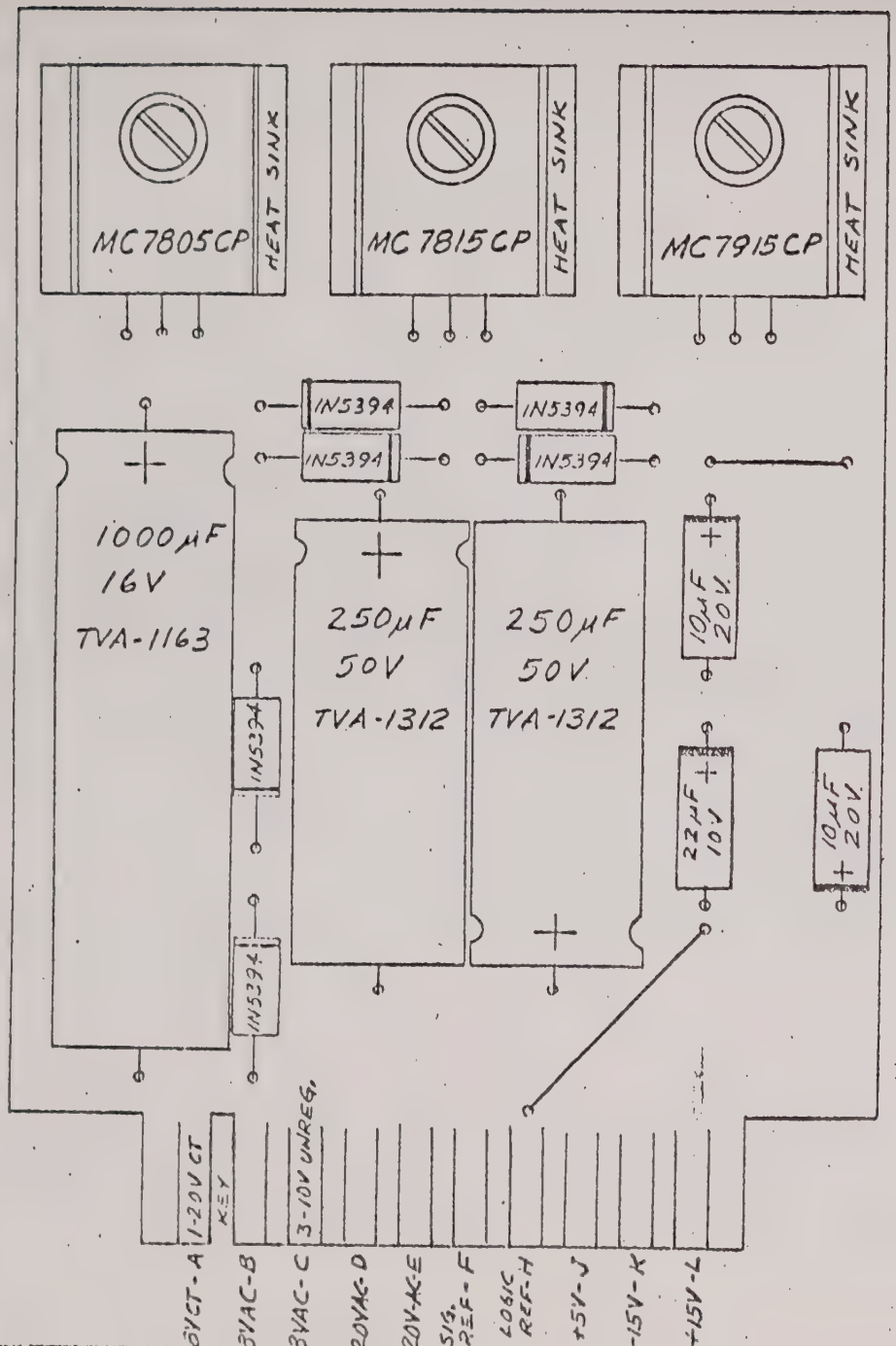
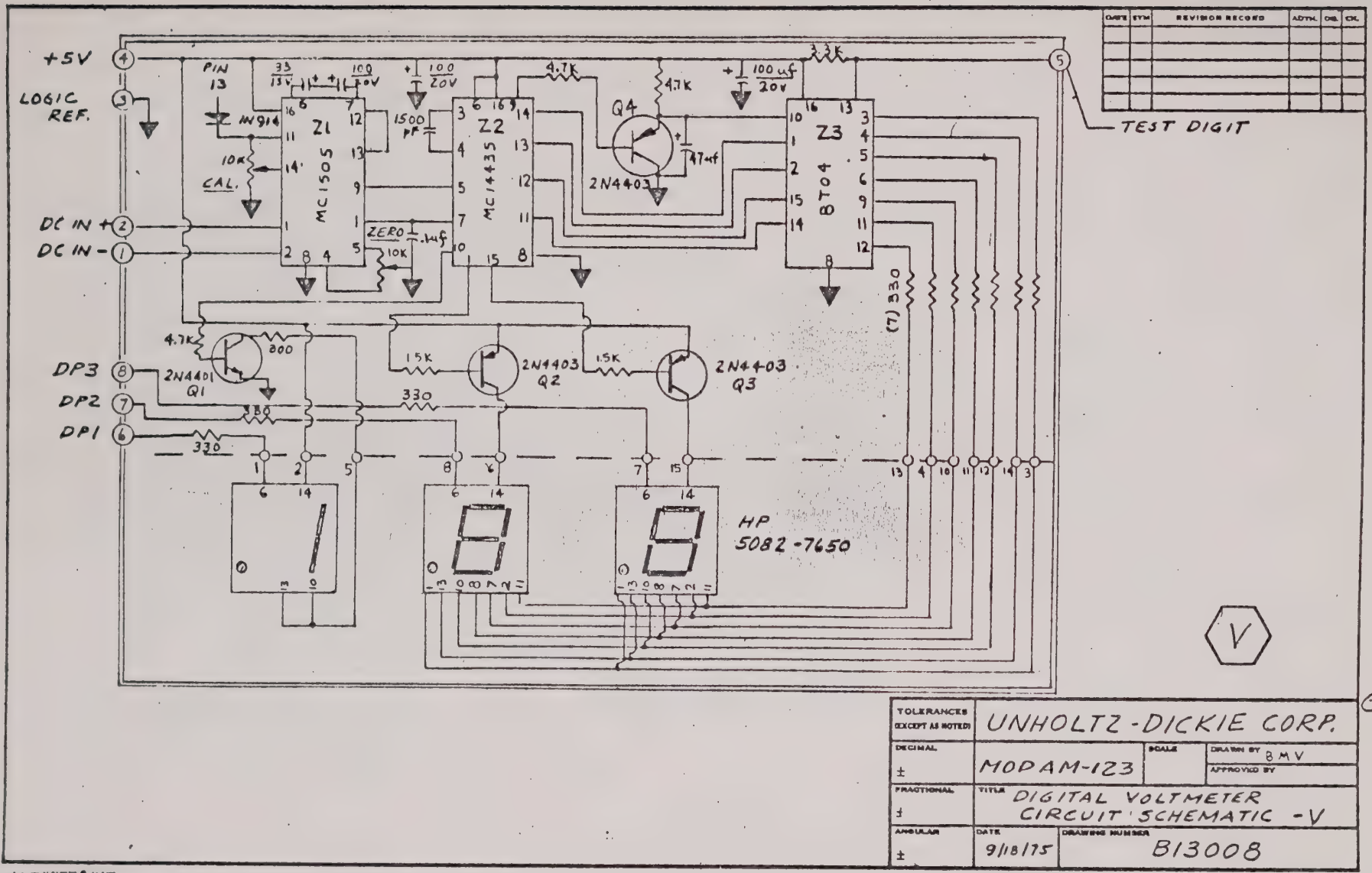


FIG. 6.21

P

	UNHOLTZ-DICKIE CORP.		
	AM-123 MOD 800	SCALE	TIC
	COMPONENT LAYOUT POWER SUPPLY CARD - P		
	M-15-75	C-12049	



REVISION RECORD				
DATE	SYM		ADTH.	CHK.

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	MODAM-123	SCALE	DRAWN BY BMV APPROVED BY
FRACTIONAL ±	TITLE DIGITAL VOLTMETER CIRCUIT SCHEMATIC -V		
ANGULAR ±	DATE 9/18/75	DRAWING NUMBER B13008	

C

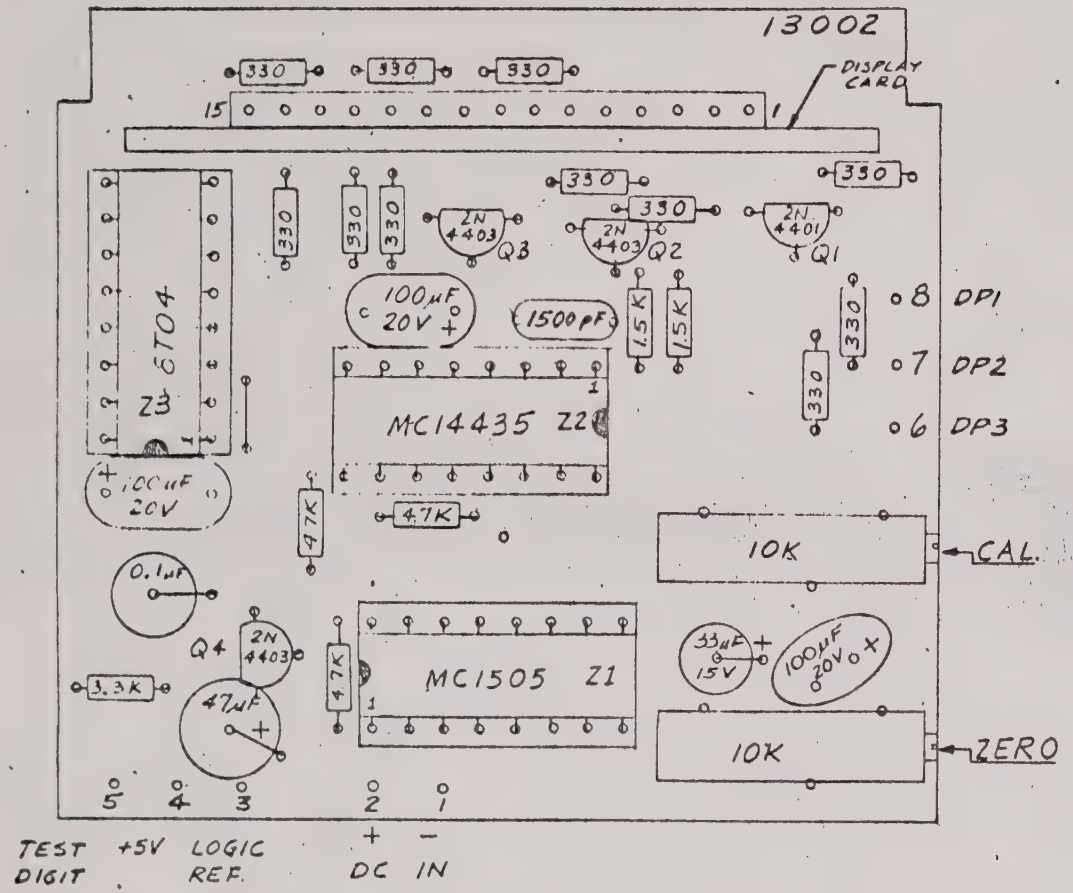
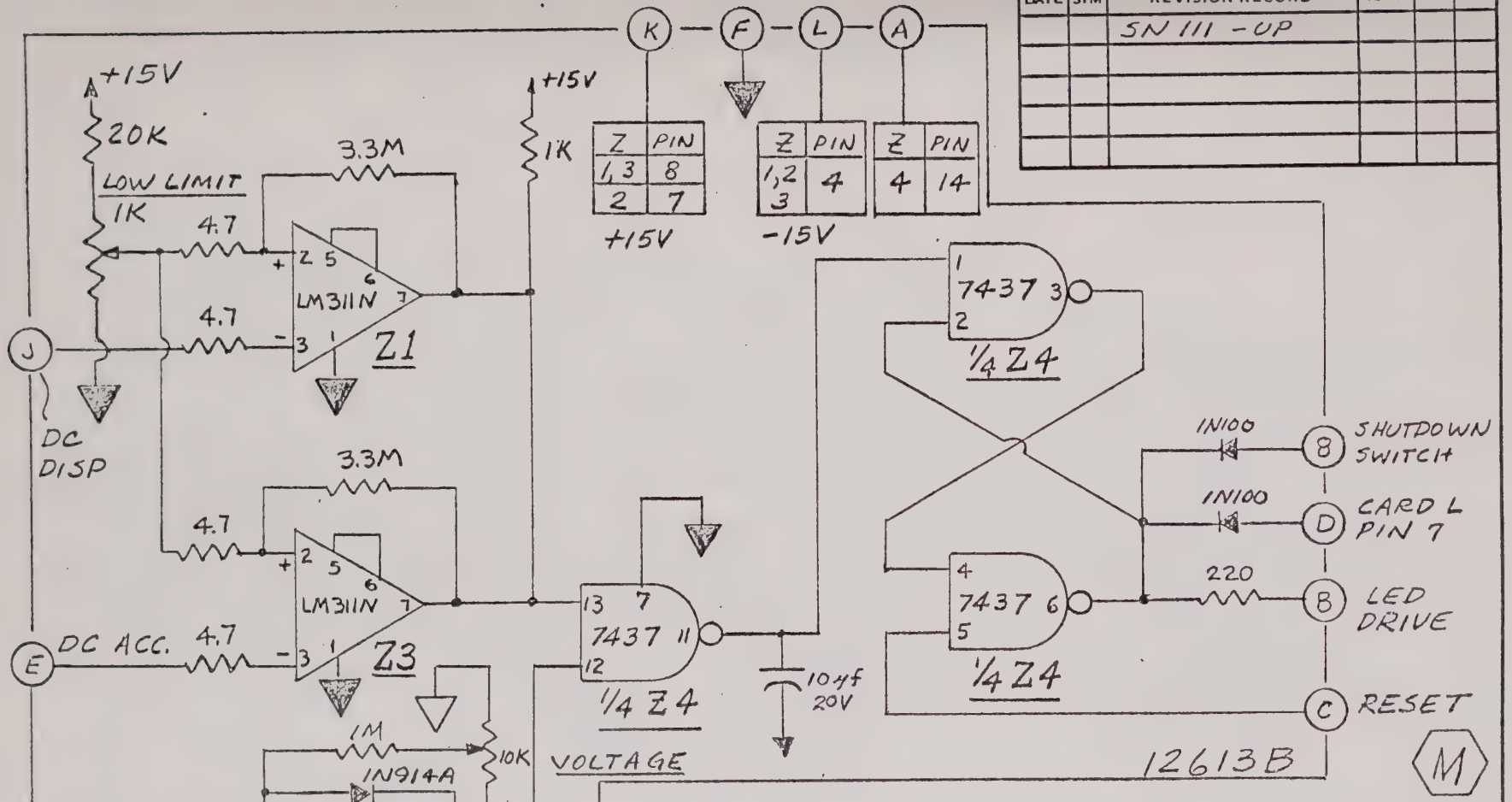


FIG. 6.23

V

TOLERANCES EXCEPT AS NOTED	UNHOLTZ - DICKIE CORP.
DECIMAL ±	AM-123 MOD. 800
FRACTIONAL ±	TITLE COMPONENT LAYOUT DIGITAL VOLTMETER -V
ANGULAR ±	DATE 9/12/75 C13007

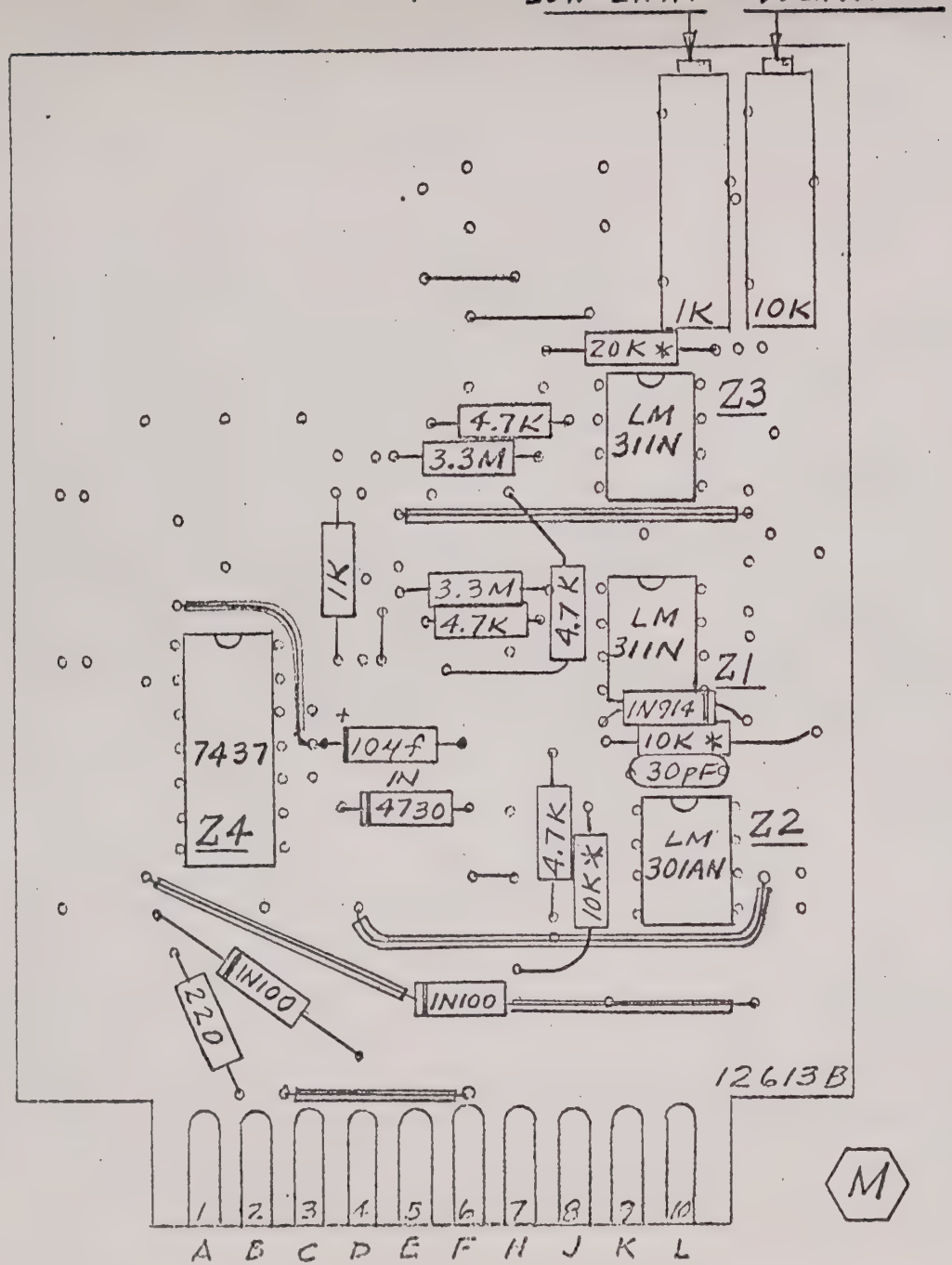


DATE	BY	REVISION RECORD
		SN 111 - UP

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ - DICKIE CORP.
DECIMAL ±	AM-123
SCALE	
DRAWN BY BMV	
APPROVED BY	
FRACTIONAL ±	TITLE LOW LIMIT COMPARATOR - LATCH CIRCUIT SCHEMATIC
ANGULAR ±	DATE 4-6-77
DRAWING NUMBER	A11629

K·E ALBANEY ENGINEL 10 5465 STANDARD FORM

MADE U.S.A.



PIN FUNCTION

CONDUCTOR (REV.) SIDE	
A	+5V REG
B	LOW LIM. LED DRIVE
C	RESET
D	CARD L-PIN 7
E	DC ACC. IN
F	REF.
H	OUTPUT VOLT. (AC)
J	DC DISP. IN
K	-15V REG
L	+15V REG
COMPONENT (FRONT) SIDE	
1	——
2	
3	
4	
5	
6	——
7	
8	SHUTDOWN SWITCH
9	——
10	——

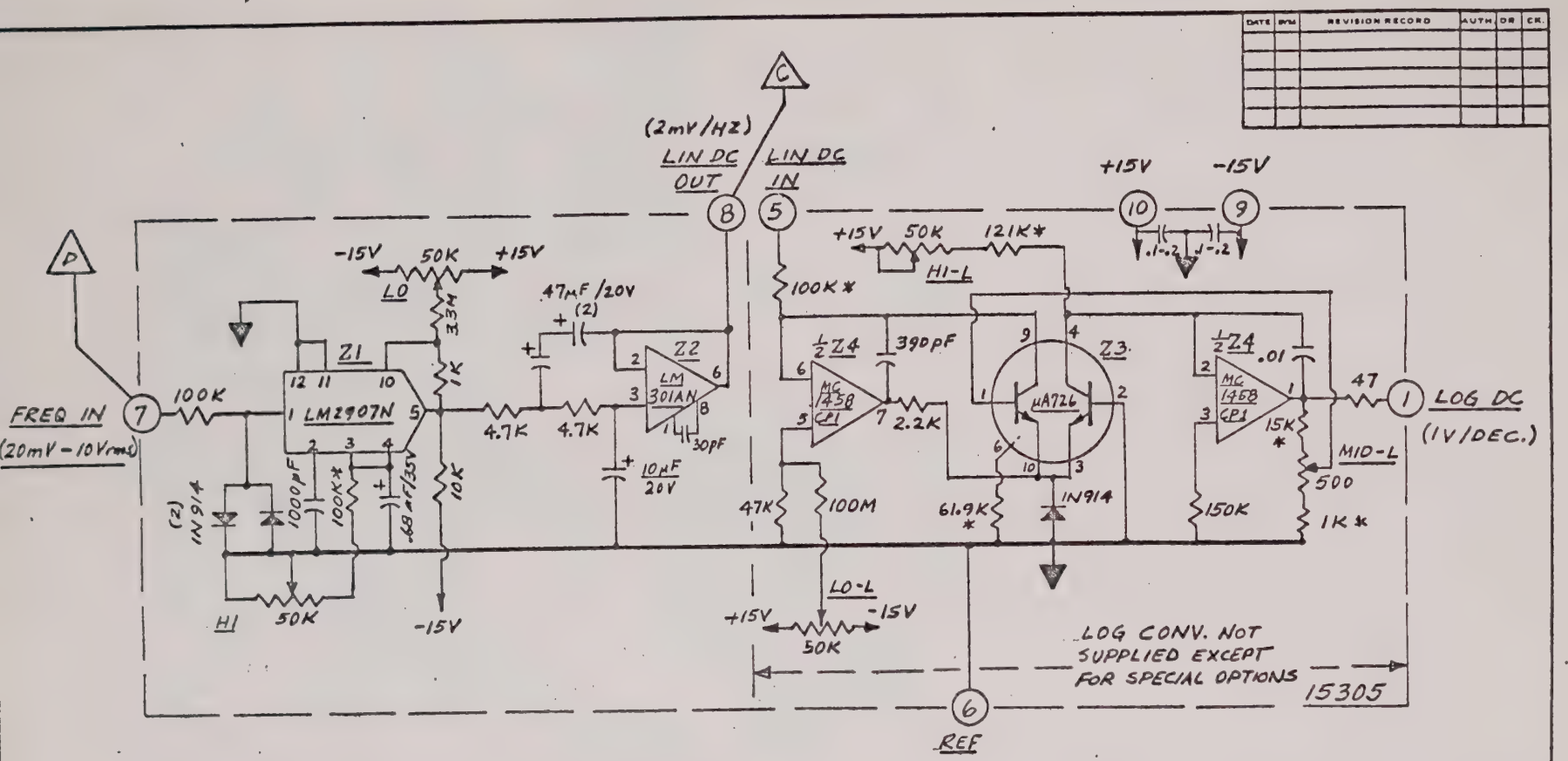
UNHOLTZ-DICKIE CORP.

AM-123

LOW LIMIT COMP.-LATCH

4-5-77 A11630

FIG 6.25



DATE	BY	REVISION RECORD	AUTH	DR	CK

Z	TYPE	PINS +15V	PINS -15V
1	LM2907N	9,8	NC
2	LM301AN	7	4
3	μA726	8	5
4	MC1458CP1	8	4

TOLERANCES (UNLESS OTHERWISE NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±		SCALE	DRAWN BY TU
			APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC F-V CONVERTER + LOG FREQ.		
ANGULAR ±	DATE 12-5-77	DRAWING NUMBER 815306	

N

C

MADE IN U.S.A.

K·E ALBANENE @ 10 0469 ENGINEERS' STANDARD FORM

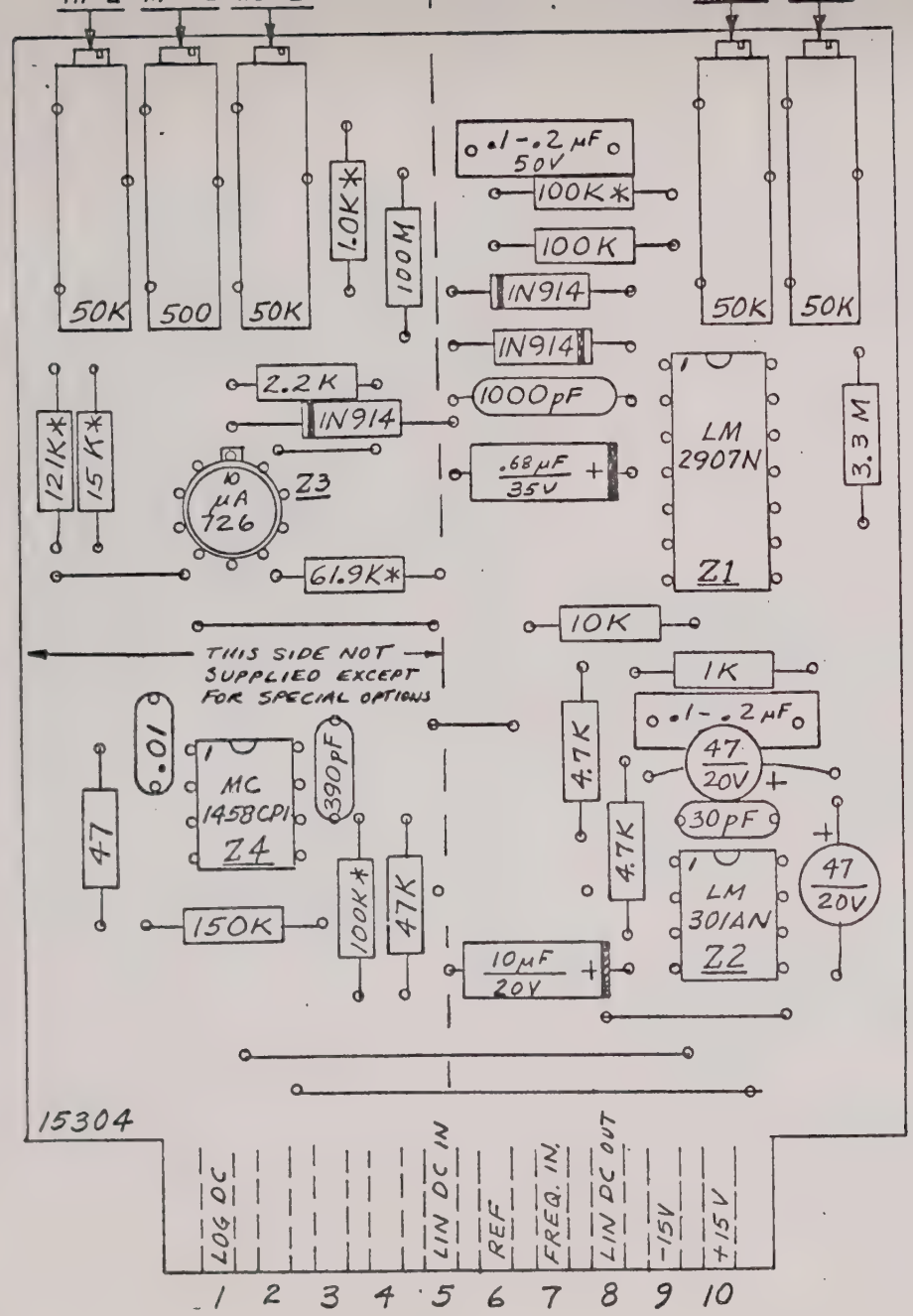
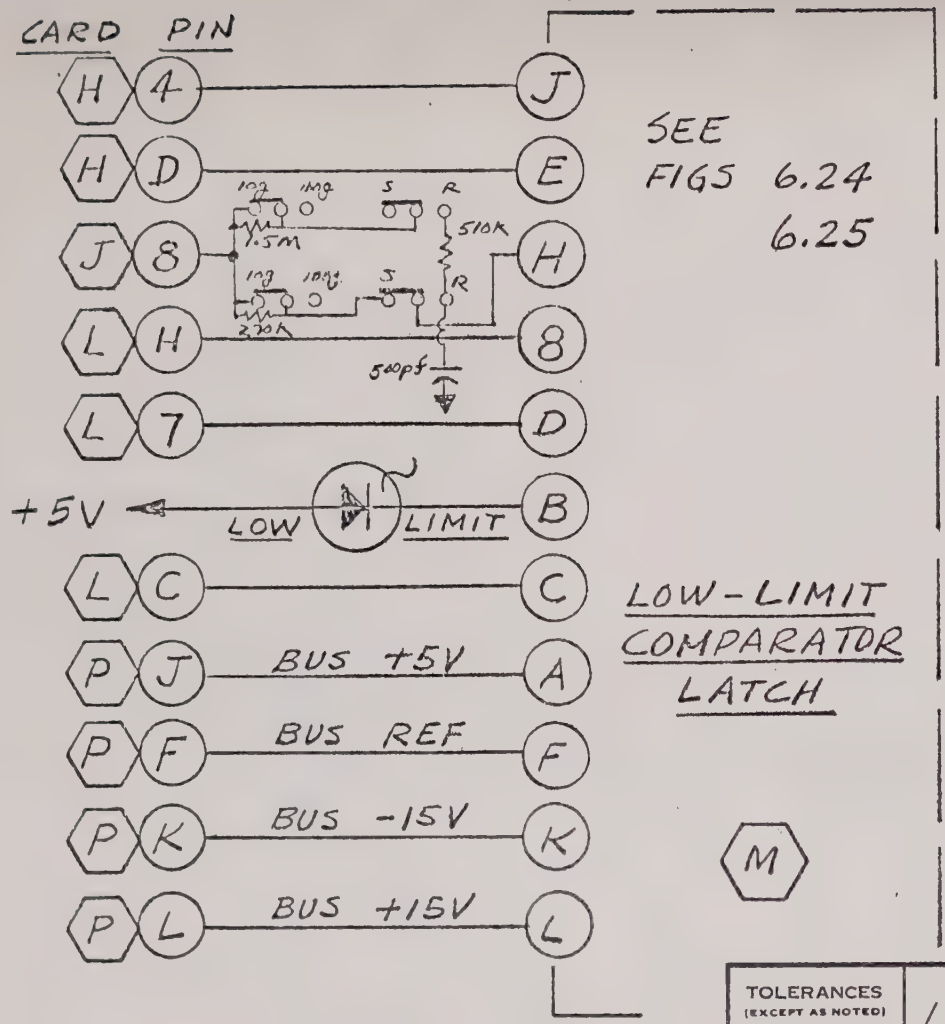


FIG 6.27

N

TOLERANCES	UNHOLTZ-DICKIE CORP		
DECIMAL		SCALE	DRAWN BY TU
FRACTIONAL	TITLE COMPONENT LAYOUT F-V CONV & LOG CONV.		APPROVED BY
ANGULAR	DATE 12-2-77	DRAWING NUMBER C15305	

DATE	SYM	REVISION RECORD	AUTH	DR.	CK.
3/77		Change Pontan Gain	LEM		



SEE FIGS 6.24 6.25

LOW-LIMIT COMPARATOR LATCH

SN 111 UP

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP		
DECIMAL ±	AM-123	SCALE -	DRAWN BY TU / APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT ADDITIONS LOW-LIMIT FEATURE		
ANGULAR ±	DATE 4-6-77	DRAWING NUMBER A11631	

FIG 6.28

K•E ALBAN E ® 10 5465 ENGIN S' STANDARD FORM

M IN U.S.A.

7. SPECIFICATIONS

7.1 FREQUENCY RANGE 5 Hz to 5 kHz

7.2 INPUTS

7.2.1	Charge input:	Adjustable for sensitivities 1-100 pC/g in two ranges; rear-panel selection of 2.1 or 2.2.
7.2.2	Voltage input:	Adjustable for sensitivities 1-100 mV/g in two ranges; input impedance 100K (adjust to 10 mV/g for signal conditioners
7.2.3	Random/Sine input:	13 V peak; input impedance 10K; for servos other than U-D Model SPA-7 or OSP-4.
7.2.4	Oscillator input:	50 mV pp to 30 V pp, 5 Hz to 5 kHz

7.3 OUTPUTS

7.3.1	Lin. Frequency:	2 mV/Hz, 10 V max ±1% ±5 mV
7.3.2	Random/Sine output:	Normally unity gain ±5%; compresses to an attenuation of greater than 80 dB upon command from TTL limit detection circuit.
7.3.3	Acceleration:	1 V peak for full scale input; 10 V max.; frequency response ±1% 5 Hz to 5 kHz.
7.3.4	Displacement:	1 V peak for full scale input; 10 V max.; frequency response ±3% 5 Hz; ±1% 10 Hz to 1 kHz.
7.3.5	Shutdown Controls:	(1) TTL logic 1 for normal operation, logic 0 for shutdown; for SPA-7 or OSP-4 and internal compressor. (2) NC contacts opening when internal compressor compresses approximately 80 dB to cause other sine controllers to go to standby mode. NO contacts optional. (3) NC contacts opening 100 ms after limit detection if overlimit condition has not been corrected. NO contacts optional.
7.3.6	Digital Meter:	2½ digit display; resolution ±1 LSD, decimal point automatically placed; reads peak acceleration and peak to peak displacement for sine, and rms values for random signals. Max. reading 199% of nominal full scale value.
7.3.7	Function Indicators:	Six lamps show function measured and units of measurement. See 4.1 and 4.2.

7.4. OPERATING CONTROLS

7.4.1 Acceleration Ranges: 10 g, 100 g full scale (peak sine or rms random) (two lamps)

7.4.2 Displacement Ranges: 100 mil, 1.0 in full scale (p-p sine or rms random) (four lamps)

7.4.3 Range switches push in or out to select full scale ranges for monitoring and limiting.

7.4.4 Mode switch pushes in or out to select random or sine operation.

7.4.5 Function switch pushes in or out to determine displacement or acceleration monitoring on meter; Operation in 5.3 overrides this selection.

7.5. LIMITING

7.5.1 Displacement and acceleration values separately adjustable from 1% to 199% of full scale value.

7.5.2 Exceeding either limit immediately trips latching TTL protection circuits and shows overlimit on front panel LED indicators.

7.5.3 Momentary contact pushbutton displays limit values on digital meter.

7.5.4 Low acceleration or displacement limit adjustable at rear from 0 to 50% of full scale value, and compressor output limit adjustable from 0 to .7 V rms such that latching protection circuit is tripped if acceleration/displacement level is below set limit and output voltage is above set limit simultaneously. LOW LIMIT condition is shown on front panel by a LED indicator.

7.6. RESPONSE TIMES

7.6.1 Detection time constant

Sine: Controlled by lin. frequency signal-at least 5 times faster than servo time constant.

5 Hz - 200 ms
150 Hz - 6 ms Typical values
5 kHz - .2 ms

Random: Constant at approximately 300 ms for acc.; 500 ms for displacement.

7.6.2 Compression time for 80 dB compression (internal compressor - SPA-7 and OSP-4 characteristics similar)

Sine: Controlled by lin. freq. signal

5 Hz - 500 ms
150 Hz - 150 ms Typical values
5 kHz - 5 ms

Random: Constant at approximately 50 ms.

7.7. OTHER CONTROLS

7.7.1 Shutdown Switch (In-Bypass): Bypass position prevents outputs in 3.4 from being active.

7.7.2 Reset: Momentary depression resets limit latches, and returns internal compressor to unity gain. Test is resumed by usual techniques which return sine servo from standby to operate mode.

7.8. POWER: 105-125/210-250 V AC 50-60 Hz 10 VA

7.9. SIZE: 3.5 in high x 19" wide x 11 in deep + cables.

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